An Assessment Of The General Status Of Marine And Diadromous Fish Species in the southern Gulf of St. Lawrence Based On Annual Bottom-Trawl Surveys (1971-2002).

H. P. Benoît, M.-J. Abgrall, and D. P. Swain

Fisheries and Oceans Canada
Gulf Fisheries Centre
P.O. Box 5030
Moncton, N.B.
E1C 9B6

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AN ASSESSMENT OF THE GENERAL STATUS OF MARINE AND DIADROMOUS FISH SPECIES IN THE SOUTHERN GULF OF ST. LAWRENCE BASED ON ANNUAL BOTTOM-TRAWL SURVEYS (1971-2002).

by

H. P. Benoît, M.-J. Abgrall and D. P. Swain

Fisheries and Oceans Canada
Gulf Fisheries Centre
P.O. Box 5030
Moncton, N.B.
E1C 9B6

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Abstract

One of the commitments under the 1996 federal-provincial-territorial *Accord for the Protection of Species at Risk* includes regularly monitoring, assessing and reporting on the status of all wild species throughout Canada. These assessments are meant as rapid evaluations of status and are a means of prioritising the more detailed assessment of extinction risk conducted by the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC). The present report is intended to contribute to an assessment of the general status of all Canadian marine fish, which is currently under way. We present general status indicators for fifty-nine marine fish and four diadromous fish species sampled in an annual bottom-trawl survey of the southern Gulf of St. Lawrence (sGSL), conducted each September since 1971. The status of each species was determined by considering trends in population size, geographic distribution and size-composition over time. A prioritised list of species requiring a broader-scale analysis because of indications of diminishing status in the sGSL is presented.

Résumé

L'un des engagements de l'*Accord pour la Protection des Espèces en Péril* conclu par les gouvernements fédéral, provinciaux et territoriaux en 1996, comprend la surveillance, l'évaluation et le compte rendu à intervalle régulier de la situation générale de toutes les espèces sauvages du Canada. Ces évaluations ont pour but de rapidement déterminer le statut des espèces afin de donner à celles soupçonnées d'être en risque de disparition la priorité d'une évaluation détaillée par le *Comité sur la Situation des Espèces en Péril au Canada* (COSEPAC). Le présent rapport vise à contribuer à l'évaluation actuelle de la situation générale de toutes les espèces de poissons marins du Canada. Nous présentons des indicateurs du statut général de cinquante-neuf espèces de poissons marins et de quatre espèces de poissons diadromes capturés au cours des relevés annuels par chalut de fond effectués en septembre dans le sud du Golfe St.-Laurent depuis 1971. Le statut de chaque espèce a été déterminé selon les tendances illustrées au cours des années par la taille de sa population, sa distribution géographique et sa structure de tailles. Suite aux indications de déclin dans le statut de certaines espèces dans le sud du Golfe, une liste prioritaire d'espèces nécessitant une analyse à plus grande échelle a été établie.

1. Introduction

1.1 Background

In 1996, federal, provincial and territorial ministers responsible for wildlife outlined commitments to designate species at risk, protect their habitats and develop recovery plans in the *Accord for the Protection of Species at Risk*. One of the commitments under the *Accord* includes regularly monitoring, assessing and reporting on the status of all wild species throughout Canada, noting which species are currently secure, which need to be monitored more closely, and which need to be formally assessed and perhaps protected. These assessments are meant to be rapid evaluations of status based on an integration of the best possible existing information on population sizes, trends, distribution, and threats. They also serve to identify where information gaps exist. These are not meant as detailed assessment of extinction risk such as those conducted by the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC), but rather as an aid in prioritising the activities of this committee, among other things.

The first *Wild Species in Canada* report (*Report 2000*, CESCC 2001) contained general status assessments for a broad cross-section of over 1 600 Canadian species, from all provinces, territories, and ocean regions. Species from eight major groups were evaluated, namely, freshwater fishes, amphibians, reptiles, birds, mammals, butterflies, ferns, and orchids. The system adopted effectively prioritised species in terms of the effort and attention needed to prevent their loss. Species were classified as either *Extirpated/Extinct, At Risk, May Be At Risk, Sensitive, Secure, Undetermined, Not Assessed, Exotic*, or *Accidental*.

An assessment of the general status of all Canadian marine fish is currently under way and should be completed and published in a *Wild Species in Canada* report in late 2004. Following the approach adopted in the *Report 2000*, the intent of the exercise is to:

- develop a comprehensive and taxonomically updated list of all marine fish (non-diadromous) species that occur in Canada;
- determine which species are currently secure and which need to be closely monitored;
- determine which species need to be formally assessed by COSEWIC and perhaps protected;
- determine which species require further research in order that a proper designation can be made, and,
- create an inventory of the quality and quantity of information available for each species.

The latter objective is of particular importance given that the general status of marine fishes will be reviewed every five years. This obligation to regularly review general status ranks also advocates for a streamlining or automation of the assessment process to the extent feasible. While this may not be possible for many species where data are spotty, it is likely achievable for those species that are regularly sampled in standardised surveys, such as the bottom-trawl surveys conducted annually throughout Atlantic Canada. The work presented in this report was undertaken with that objective in mind.

1.2 National Approach

Nationally, the goal of the exercise is to assess the general status of marine fish species in Canadian waters. Although many Canadian marine fish species also occur in foreign or international waters, assessments will be based on domestic status only.

Under the national approach, general species status ranks will be derived by considering available information relating to seven criteria that collectively help define status:

- **Population size and abundance** - the current estimate of the total number of mature individuals capable of reproduction;
- **Number of occurrences** - estimated number of sites where the species currently persists, and is commonly used as a proxy for distinct (sub-) populations;
- **Geographic Distribution** - the current area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred, or projected sites of occurrence, excluding cases of vagrancy;
- **Trends in Population Size** - the percentage change in the number of mature individuals (disregarding natural fluctuations, to the extent possible) over the last 10 years or three generations, whichever is longer;
- **Trends in Distribution** - the percentage change in the species' range over the last 20 years or six generations, whichever is longer;
- **Threats to population size** - observed, inferred, or projected mortality, including effects of direct exploitation, harassment, exotic species, or ecological interactions with predators, competitors, pathogens, or parasites that may result in population declines; and,
- **Threats to habitat** - observed, inferred, or projected habitat alterations (loss, alteration, degradation, or fragmentation) that may result in population declines.

Information for these seven criteria from the various regions or fisheries management areas will be rolled into a single overall assessment for each species. To aid in this process, we have compiled the necessary relevant information for the southern Gulf of St. Lawrence (sGSL). This information is presented as a general status assessment for the populations of species that inhabit the sGSL. It is important to note that these results do not necessarily reflect the overall status of the species, as all of those considered also occur outside of this area.

1.3 Regional Approach

Bottom-trawl surveys have been conducted annually in the sGSL during the month of September since 1971. Overall, we feel that standardised regular surveys such as this are the main source of useful information in assessing long-term changes in the status of a broad range of marine fish species. Standardised industry surveys, such as Atlantic

Canada's Sentinel programs may also prove valuable in status assessments, but have been in existence for too short a time to be currently useful in considering decadal-scale population trends. Fishery-dependent data are also unsatisfactory in many cases. There are many pitfalls associated with relying on catch and effort data to provide indices of abundance (Hilborn and Walters 1992), and landings are greatly affected by fishery management measures and market demands. Records of fishery bycatch depend on coverage by fisheries observers and their ability to correctly identify species. We do recognise however, that these sources of information will be necessary in completing the picture of overall species status, particularly as it relates to identifying threats to species and habitat. We also recognise that for many species, survey data will be unavailable or unreliable, and that these other sources of information will be helpful in obtaining a broad impression of trends in abundance and distribution.

The assessments presented here are based entirely on the September survey of the sGSL, covering the period from 1971 to 2002. Of the seven criteria for general status assessment outlined in section 1.2, we focus on three in particular: trends in population size, distribution and trends in distribution. We also note any relevant threats to abundance and to distribution where these are known or purported to be known, but we do not make any speculations that are not substantiated in published scientific reports. We do not include population size and abundance as a criterion given that this information can only be estimated for a small number of species (by sequential or virtual population analysis). Catches from bottom-trawl surveys provide relative indices of abundance, which can only be used to compare relative abundance of a species in time or space. We also do not include the number of occurrences as a criterion because distinct sub-populations have not been reliably identified for the marine fish species captured in the sGSL survey, although such a case is suspected for species such as herring (spring and fall spawning components), winter flounder and white hake.

In addition to the general status indicators discussed above, we also present information on changes in the body-length composition of species in the survey over time. Such information is often crucial in understanding the demography and dynamics of populations (Begon and Mortimer 1986). Furthermore, one of the major impacts on natural fish populations, fishing, is known to be size-selective (Sinclair et al. 2002). We present this information both as a series of annual length-frequencies as well as time series of percentiles from the length-frequencies (median, 75th and 95th percentiles, and maximum length captured).

Overall, we present a general status assessment for 63 species of fish captured in the annual sGSL survey. Although the next *Wild Species in Canada* report will not include diadromous fishes, we have nonetheless completed general status assessments for the four species of diadromous fishes captured in the September survey (gaspereau, American shad, treespine stickleback, and rainbow smelt). In presenting our results, we note cases where the survey may not be providing a reliable assessment of species status. We also provide a rough indication of the percentage of the species range in Canadian Atlantic waters that is contained in the sGSL in September. This should help readers in determining how broadly to extrapolate the results we observe in the sGSL when making a determination of overall status nationally.

2. Methods

2.1 Annual survey

The annual sGSL bottom-trawl survey follows a stratified random design, with stratification based on depth and geographic area (Fig. 1). Three inshore strata (401-403) were added to the survey in 1984. Consequently, results are presented as two separate time series, from 1971-2002 (strata 415-439) and from 1984-2002 (strata 401-439) (see section 2.2 for details).

The September surveys were carried out by the *E.E. Prince* from 1971 to 1985 using a Yankee-36 trawl, by the *Lady Hammond* from 1985 to 1991 using a Western IIA trawl and by the CCGS *Alfred Needler* since 1992 also using a Western IIA trawl. The target fishing procedure in all years was a 30-minute tow at 3.5 knots (all catches have therefore been standardised to a 1.75 nautical mile tow). Fishing was restricted to daylight hours (07:00-19:00) from 1971 to 1984 but has been conducted 24-hr per day since 1985. Adjustments for differences in catchability between vessels and gears, based on comparative fishing experiments in 1985 and 1992, have been made where applicable (Benoît and Swain 2003b, *in prep.*; Nielsen 1994). Similarly, adjustments for diel differences in catchability have been applied where necessary (Benoît and Swain 2003a, *in press*). Where adjustments were applied, catches were adjusted to be equivalent to day catches by the *Alfred Needler* using a Western IIA trawl. Further details on the annual survey can be found in Hurlbut and Clay (1990).

Although the survey protocol since 1971 has been to sort (and record) catches of finfish by species, identification at sea is problematic for four genera in particular: *Liparis* (seasnails), *Lycodes* (eelpouts), *Sebastes* (redfish) and *Alosa* (gaspereau). While attempts are made to identify the former two genera to the species level, it is felt that this has been done inconsistently and the reliability of the identification is questionable. Consequently these were grouped to the genus level for the status assessment. Catches of *Liparis* spp. are likely mainly *L. gibbus* (dusky seasnail), but may also include instances of *L. atlanticus* (Atlantic seasnail), *L. fabricii* (gelatinous seasnail) and *L. liparis* (striped seasnail). Similarly, *Lycodes* spp. includes mainly *L. lavalaei* (Laval's eelpout) and *L. vahlii* (Vahl's eelpout), with a few possible instances of *L. reticulatus* (Arctic eelpout), *L. pallidus* (pale eelpout) and *L. esmarki* (Vachon's eelpout). As for redfish, no attempts are made to differentiate to species in the sGSL surveys, although these would mainly be *S. fasciatus* and *S. mentella*. Similarly, no attempts are made to differentiate *Alosa pseudoharengus* (alewife) and *A. aestivalis* (blueback herring), and consequently both fall under the collective name of gaspereau. Finally, barracudinas have been grouped to the family level (Paralepididae) because there are a few unconfirmed records of *Paralepis* *coregonoides*, although the vast majority of instances are of white barracudina (*Arctozenus risso*).

Many of the marine fishes in the sGSL undergo seasonal migrations. Many of these species migrate out of the survey area to overwintering grounds in the deep waters of the Laurentian Channel and Cabot Strait (e.g., cod, white hake, herring and American plaice). Others stay within the sGSL but change their distribution seasonally. For example, winter skate occur in shallow inshore areas in summer and early fall but disperse throughout the Magdalen Shallows in winter (Darbyson and Benoît 2003). Thus, the information presented here may only be representative of abundance and distribution in the late summer and early fall. However, because the survey is conducted during the same month each year and precedes the annual migrations to overwintering grounds, we believe that the survey results accurately reflect inter-annual changes in abundance and distribution.

2.2 Analysis

For each of the 63 species considered in this report, we calculated the following annual indices of population status.

The *mean number* of individuals captured per tow and approximate confidence intervals were calculated using the standard method for stratified sampling (Krebs 1989). In some surveys, repeat tows were made at some sites and these were weighted by the inverse of the number of repeat tows at the same site in calculations of the stratified mean and variance. Although the national general status assessment criteria focus specifically on the number of mature individuals in the population, we present average abundances for all individuals captured because maturity-at-length ogives are available for only a small number of species.

We also calculated a *stratified percent occurrence*, adopting the same methods used in calculating the *mean number* per tow, but treating catches as a binary variable of presence (1) or absence (0). This metric may provide a more reliable index of abundance for some small-bodied or pelagic species with highly variable catchability to the survey gear. Given the addition of three inshore strata in 1984, we present separate time series of *mean number* and *stratified percent occurrence* for strata 415-439 (1971-2002) and strata 401-439 (1984-2002). For the majority of species, the addition of the inshore strata has little effect on these two metrics. Even in the case of more coastal species where the addition of these strata results in higher numbers per tow and higher occurrences, trends over time are very similar between the two series. Consequently, the remaining status indicators described below are based on strata 415-439.

A number of studies have reported relationships between abundance and the distribution of marine fishes. Optimal foraging theory predicts that habitat selection should be density-dependent (Fretwell and Lucas 1970). Distribution is expected to expand into marginal habitat as abundance increases, and contract into optimal habitat as abundance decreases (MacCall 1990). This prediction that geographic range will contract as abundance declines has important consequences for species at risk. Vulnerability to exploitation increases as geographic range declines (Paloheimo and Dickie 1964). For example, Rose and Kulka (1999) reported that catch rates for northern cod remained high (or in some fisheries, even increased) as the stock collapsed. This resulted from increasing geographic concentration as the stock declined. As a result, we calculated two indices of geographic distribution in September, namely the *area occupied* and an *index of spatial aggregation* (D_{95}). Both indices are calculated utilising the survey stratification scheme.

Area occupied (A_t) was calculated for year t as follows:

$$A_t = \sum_{i=1}^{n} a_i I \quad \text{where } I = \begin{cases} 1 \text{ if } Y_i > 0 \\ 0 \text{ otherwise} \end{cases}$$

where n is the number of tows in the survey in year t, Y_i is the number of fish of the species caught in tow i, and a_i is the area of the stratum fished by tow i divided by the number of sites fished in that stratum. In cases where repeat tows were made at the same sites in a survey, a_i is the above quantity divided by the number of tows at the site fished by tow i. *Area occupied* is expressed in square kilometres. Strata 415-439 cover a total of 70075 km^2. *Area occupied* and *stratified percent occurrence* are quantitatively very similar indices, differing only in scale.

Area occupied will decrease as population size decreases even if there is no increase in geographic concentration (Swain and Sinclair 1994). In order to describe changes in geographic concentration we calculated D_{95}, the minimum area containing 95% of the individuals of the species (Swain and Sinclair 1994). To calculate D_{95}, we first calculated *F(c)*, the catch-weighted cumulative distribution function (cdf) of catch (c):

$$F(c) = \sum_{i=1}^{n} w_i \frac{Y_i}{\overline{Y}} I \quad \text{where } I = \begin{cases} 1 \text{ if } Y_i \le c \\ 0 \text{ otherwise} \end{cases}$$

where Y_i is the catch of the given species in tow i and $\overline{Y}$ is the stratified mean catch rate, and w_i is the proportion of the survey area in the stratum fished by tow i divided by the number of sites fished in that stratum. In surveys with repeat sets at the same sites, w_i is the above quantity divided by the number of tows at the site fished by tow i. *F(c)* provides an estimate of the proportion of the species that occurs at a local density of c or less. We evaluated F at intervals of 0.01 and calculated the density c_{05} corresponding to F=0.05. This is the density at or below which the most sparsely distributed 5% of the species are estimated to occur. We estimated the area containing the most sparsely distributed 5% of the species (including areas where no individuals were caught) as follows:

$$G(c_{05}) = \sum_{i=1}^{n} a_i I \quad \text{where } I = \begin{cases} 1 \text{ if } Y_i \le c_{05} \\ 0 \text{ otherwise} \end{cases}$$

Thus, the minimum area containing 95% of the species (D_{95}) is given by:

$$D_{95} = a_T - G(c_{05})$$

where a_T is the total survey area.

In addition to the annual indices of abundance and distribution described above, we also calculated the percentage change over time in the abundance (mean number per tow) index, the area occupied and D_{95}. Percentage change in occurrence is not presented, as the result would be the same as for area occupied.

In considering rates of change in abundance (or abundance indices), the COSEWIC suggests that any changes should not be interpreted as part of a natural fluctuation unless there is good evidence for this. Given that indices of abundance and distribution show considerable inter-annual variability for many of the species we considered, we adopted an exponential decay (increase) model to estimate the rate of change. The exponential form of the model was fit by iterative least-squares for the majority of species:

$$N_t = \alpha \ \exp(\beta t)$$

where N_t is the index of either abundance (mean number/tow) or distribution (in thousands of km^2) at time t, α is the intercept, β is the instantaneous rate of change, and the error is assumed to be normally distributed. This form of the model did not fit well to abundance data for 17 species for which there were many successive years of zero capture, and so the linear form was fit by least-square regression:

$$\ln(N_t + k) = \alpha + \beta t$$

where the error on the log scale is assumed to be normal and k is a constant added to deal with zero catches prior to log-transformation. The constant added was equivalent to 10% of the smallest non-zero catch observed for that species over the 32 years of the survey, to a maximum of one. This approach was used to limit any biases that may be introduced by adding too large or too small a constant.

Based on the estimated instantaneous rate of change, the percentage change over x years is:

$$\text{Percent change} = (\exp(\beta \bullet x) - 1) \bullet 100$$

Many species show both increases and decreases in abundance over the 32-yr survey time series. For these species, estimated rates of change can depend strongly on the time period used in the analysis. For this reason, we estimated percent change for a range of time spans, starting from five years prior to 2002 (i.e., 1997-2002) to 31 years prior to 2002 (i.e., 1971-2002). These values are presented in a plot of percentage change as a function of the size of the temporal window used to calculate the change (years prior to 2002). Such a plot allows the reader to rapidly determine the sensitivity of the estimated rate of change to the time period used in the analysis. Another motivation for adding these plots to the report is that they are useful in allowing the reader to obtain an estimate of percentage change for a period of choice, such as 10 years or 3 generations. It should be noted that for species that were not observed in the first portion of the survey series but which have increased exponentially since then, it is inappropriate to interpret percent changes in abundance that span back to the period when the species was not observed. The inclusion of these zero abundances in the early part of the time series slightly decreases the estimated instantaneous rate, but because the time span (x) increases, the estimated percent change increases exponentially as more and more years of zero abundance are included.

3. Results and Discussion

This section is divided into two subsections. The first provides a general description of how the results are organised, as a consistent presentation format was is used for all species. The second subsection contains the species-by-species results.

3.1 Results - General

We assessed the general status of 63 species captured in the annual survey. These are indexed in Table 1.

A general summary of the biology and habitat of each species is provided in Table 2. Much of the information provided in Table 2 is meant for future more in-depth assessments, and is not necessarily interpreted as part of this report. For example, summaries of key demographic characteristics such as age at maturity, longevity and fecundity are presented in part to aid in any future assessments of extinction risk. Information on the spawning time, habitat and known relations to man for each species, are also included as this information may be important in determining threats to abundance or habitat in a more in-depth assessment. To the extent possible, the demographic and habitat parameters in Table 2 are specific to fish from the sGSL or are taken from nearby areas where they should be similar for the given species. Exceptions are noted in the table.

Table 2 also includes two columns that collectively aid the reader in gauging the extent to which our results may be representative of the general status of a species as a whole in Canadian Atlantic waters. We present an approximate estimate of the percentage of the species range, in Northwest Atlantic Canadian waters, that occurs in the sGSL. This serves as an indicator of the extent to which the status in the sGSL may be indicative of the overall status in Canadian Atlantic waters. We also include an indication of the reliability of the survey in providing information on the relative abundance and distribution of a species captured in the sGSL in September. This includes noting cases where much of the species habitat extends beyond survey boundaries (e.g., very shallow-water species) or where catchability to the survey gear may be low and variable. Lastly, Table 2 includes the latest COSEWIC designation or priority listing for each species (COSEWIC Prioritised Candidate List, 2002).

Indicators of the overall status of each species, based on the annual bottom-trawl survey of the sGSL (1971-2002), are depicted in two series of plots, referred hereafter as Graphs 'a' and 'b'. Graph 'a' shows time trends in the various indicators of population status and distribution for each species. These indicators are presented in a series of six or seven panels, which are described below. Graph 'b' is composed of a series of 32 panels depicting annual length frequency distributions for the species.

Description of panels from graph 'a' (refer to Fig. 2):

Panel i: Index of abundance (mean number per standardised tow) with approximate 95% confidence intervals, based on strata sampled since 1971 (o; strata 415-439) and including inshore strata sampled since 1984 (▲; strata 401-439).

Panel ii: Percent change in population abundance, based on the abundance index for strata sampled since 1971, as a function of the time span used to calculate the change (years prior to 2002). For example for 8 years prior to 2002, the point on the curve provides the overall percentage change in abundance over the period 1994-2002. Symbols have been added to the curve to highlight the period covering the most recent 10 years (▼) and the minimum time for three generations of the given species (◆). Minimum generation time is the mean age at maturity for females (the sex which limits population growth for the vast majority of species considered in this report). When the period of time comprising the three generations is shorter than five years, longer than the 32 years of the survey series, or when generation time is unknown, only the 10 year mark is indicated on the plot. Cases where the three-generation time period is estimated based on similar-sized related species are indicated by a question mark (?).

Panel iii: Stratified percent occurrence with approximate 95% confidence intervals, based on strata sampled since 1971 (o; strata 415-439) and including inshore strata sampled since 1984 (▲; strata 401-439).

Panel iv: Geographic distribution in the sGSL from 1971-2002 (strata 415-439 only). Plots are presented for the total area occupied by the species as well as the minimum area that contains 95% of the population (D95). Details on these indices are provided in the Methods section (2.2 Analysis).

Panel v: Percent change in area occupied and D95 (both based on strata 415-439) as a function of the time span used to calculate the change (years prior to 2002). Interpretation of this panel is analogous to panel ii. Symbols have been added to the curve to highlight the period covering the most recent 20 years (▼) and, where the data permit, the minimum time for six generations of the given species (◆). When the period of time comprising the six generations is longer than the 32 years of the survey series or when generation time is unknown, only the 20 year mark is indicated on the plot. Cases where the six-generation time period is estimated based on similar-sized related species are indicated by a question mark (?).

Panels vi and vii: Collectively these panels show time trends in the length (cm) composition of the species from 1971-2002. Length composition is summarised by the median, 75th and 95th percentiles, and maximum sizes in a given year. Together, these metrics are typically graphed in two separate panels in order to maximise the resolution on the y-axis, although for species where there is little length variability they are combined into a single panel and only a subset of the metrics are displayed. The reader should keep in mind that the interpretation of trends in the median, 75th and 95th percentiles should only be made in conjunction with the yearly length frequency distributions (graph b), as these metrics can vary with changes in both the small and large-bodied portions of the population.

3.2 Results and Discussion – Species-by-species

This section provides a description of the general status of each species based on the September survey.

3.2.1: Barracudinas (Paralepididae spp.)

Barracudinas are a mesopelagic fish occurring mainly in the relatively deep waters of the Laurentian Channel (Benoît et al. 2003).

Barracudinas were almost never captured prior to 1984, and much more frequently after 1985 (Fig. 3a). Although the survey abundance index for barracudinas is somewhat variable, abundance has clearly increased dramatically since 1984, resulting in a 130% increase over the past 10 years. These increases cannot be attributed to the vessel and/or gear changes that occurred in 1985 and 1992 because abundance and percent occurrence increased gradually to maximum levels in the mid to late 1990s. Area occupied by barracudinas within the survey region has increased by over 200% in the past 20 years.

The length-frequency of barracudinas in the survey has varied from year to year but without any trends (Fig. 3a,b).

3.2.2 Gaspereau (*Alosa pseudoharengus*)

Gaspereau is an anadromous species commonly found in the streams tributary to the sGSL in late spring-early summer (DFO 2001), and along much of its shores in the fall (Benoît et al. 2003). Given this coastal distribution in September, the survey likely samples only a portion of the gaspereau population. The resulting abundance index is somewhat variable, with high mean numbers per tow in certain years resulting typically from one or two very large catches (Fig. 4a). Although we calculated a decline in abundance on the order of 40% over three generations, this stems mainly from a very large value for the abundance index in 1994. Overall, the abundance index has varied without trend for at least twenty years. Percent occurrence, which provides an indicator of abundance that is insensitive to the occasional large catch, has varied between 2-12%

since 1980. Although gaspereau were captured a little more frequently in the 1970s, there has not been a marked trend in percent occurrence from 1980 to 2002.
The area occupied by gaspereau in the sGSL survey area has varied widely between about 2000 and 14000 km^2 since 1971, with the higher values occurring in the 1970s. Over the past 6 generations an overall decline of over 50% is calculated in both the area occupied and in D95, although given the inter-annual variability in the series, these calculated declines should be interpreted very cautiously.

The length composition of gaspereau in the annual survey has varied considerably, with shifts towards smaller sized-individuals approximately every five years (Fig. 4a). This typically reflects the appearance of a mode of small individuals (<15 cm) during those years (Fig. 4b). Interestingly, the survey appears to track these modes from one year to the next as the fish grow. Overall however, there do not appear to be any long-term trends in the length composition of survey catches, aside from a slight decrease in the maximum sizes captured during the last five years.

Given the variability in the data on gaspereau from the September survey, we are unable to draw any strong conclusions regarding changes in the status of this species in the sGSL from 1971-2002. Interested readers should consult the most recent stock status report for a more appropriate and comprehensive summary of the status of gaspereau in this area (DFO 2001).

3.2.3: American shad (*Alosa sapidissima*)

American shad is an anadromous species which, in September, occurs principally in inshore waters in the sGSL (Benoît et al. 2003). It is infrequently captured in the September survey, and as a result there are no discernible trends in abundance or distribution from the survey (Fig. 5 a,b). For a more comprehensive review of the status of American shad throughout Atlantic Canada, see Chaput and Bradford (2003).

3.2.4: Atlantic herring (*Clupea harengus*)

Atlantic herring is a pelagic species commonly found in nearshore and coastal waters shallower than 100 m in the sGSL (Benoît et al. 2003).

The abundance of herring in the September survey was low during the 1970s and early 1980s, but has been relatively high starting in 1984 (Fig. 6a). This increase in survey abundance mirrors patterns observed in the fishery (DFO 2002a) suggesting that the increase in the mid-1980s was not due to a change in catchability resulting from the change in survey vessel and gear in 1985. While there is much annual and inter-annual variability in the index, it is clear that abundance of herring has been stable or increasing for over 15 years. The same is true for percent occurrence, area occupied and D95. Indeed, over the past six generations of herring, the area occupied in September has increased by over 60%.

The length distribution of herring in the survey varies considerably from year to year, but there are no indications of any long-term changes in size composition (Fig. 6a,b).

3.2.5: Arctic cod (*Boreogadus saida*)

Aside from one occurrence in 1976, arctic cod have been captured in the September survey only from 1994 to 1999 (Fig. 7a,b), coincident with a cold water period in the sGSL (Drinkwater et al. 2002). The recent occurrences in the survey area appear to reflect a large-scale environmentally-driven shift in distribution (see Lilly and Simpson, 2000). Thus, it is impossible to assess the general status of this species based on the September survey data.

3.2.6: Atlantic cod (*Gadus morhua*)

The status of Atlantic cod throughout Canadian Atlantic waters was thoroughly evaluated by Smedbol et al. (2002) using research survey and fishery information. That document should therefore be used for any assessment of the status of this species in Canada. The evaluation presented here for cod in the sGSL, based on survey information only, is much less comprehensive and is intended mainly to allow comparison with the other species of marine fish captured in the September survey.

Atlantic cod has historically been, and continues to be, the most important species in the sGSL groundfish fishery. Abundance of this species in the survey has varied enormously since 1971, with a period of low abundance in the early 1970s followed by a period of historically high abundance in the 1980s (Fig. 8a). It is generally accepted that the recovery in the late 1970s was a result of very strong recruitment (Chouinard et al. 2003). The stock collapsed during the late 1980s-early 1990s, and has remained at historically low levels since 1992, despite a moratorium on fishing from 1993 to 1998 and a relatively small fishery since 1999 (6,000 t). Although there has been little change in the abundance of the stock over the last decade, the decrease over the last three generations represents a change of more than 80%. However, estimated rates of decline for this population are strongly influenced by the large increase in abundance in the late 1970s. Over a longer time period (1971-2002), the estimated overall population decline is about 20-30%.

Although the abundance index has varied little in the past decade, the percent occurrence of cod has decreased continually over that period, from more than 90% in 1992 to about 80% of sets in 2002. Over the past 20 years, the area occupied by cod in the sGSL has decreased by about 10%. Although we are unable to comment on the change in area occupied over six generations, there does not appear to be a significant change over the survey series. More alarming though is the decrease in D95 by over 40% in the past 20 years, and about 20% over the entire series. Cod, which were once dispersed throughout the sGSL, are now increasingly concentrated in the eastern and southern portions of the survey area (Benoît et al. 2003; Chouinard et al. 2003).

The proportion of very large fish in the population declined in the early 1970s (Fig. 8a,b). The strong recruitment that led to the rebuilding of this stock in the late 1970s and early 1980s is evident in the length frequency distributions and in declines in percentiles of the length distribution during that period. Length distributions remained stable from the mid-1980s to the early 1990s. The proportion of large fish increased somewhat after the closure of the fishery in the early 1990s, though maximum length declined throughout the 1990s. The increases in the median, 75th and 95th percentiles of the length distribution in the 1990s reflect the reduced fishing mortality during this period, whereas the declines in maximum length probably reflect the loss of very old cohorts, depleted by fishing in the 1980s and early 1990s.

It is clear that the overall status of Atlantic cod in the sGSL is of concern given the downward trends in most of the indicators discussed above. This is particularly so given the re-opening of a small (6,000 t) commercial fishery for this stock in the late 1990s. The most recent stock assessment advice suggests that, given relatively high current levels of natural mortality, rebuilding of the population is unlikely in the short to medium term in the absence of fishing, and that even a small fishery is likely to lead to continued declines (Chouinard et al. 2003).

3.2.7: Greenland cod (*Gadus ogac*)

In September, Greenland cod occur primarily in the southern half of the survey area, in a band spanning from the Gaspé peninsula, the waters north of P.E.I. and to Cape Breton Island (Benoît et al. 2003).

There appears to be decadal-scale variability in the abundance of Greenland cod, with relative abundance peaking during the mid-1970s and again in the mid-1990s, with an intervening period of low abundance (Fig. 9a). Recent abundance levels for this species have been near or above average.

The area occupied by Greenland cod in September has varied concomitantly with abundance, resulting in an increase of over 250% over the past two decades and close to 200% over the survey series. Patterns in D95 mirror those in area occupied.

The length distribution of Greenland cod has been progressively shifting to smaller sizes since about 1980 (Fig. 9a,b). This reflects mainly a change in the modal length of individuals captured, rather than an increase in abundance of small fish. This downward trend is not reflected the maximum length of Greenland cod captured, however.

3.2.8: Haddock (*Melanogrammus aeglefinus*)

Haddock in the sGSL and the Scotian Shelf is considered a single stock (NAFO 4TVW). In the September survey area, it is typically found north of Cape Breton Island, with deeper forays into the sGSL during high abundance periods (Benoît et al. 2003). Clearly a large portion of the population occurs outside of the survey area, and consequently sources for the Scotian Shelf should be consulted in determining overall status levels (DFO 2002b).

Abundance of haddock in the September survey has generally been low, with the exception of the period from the early to late 1980s, when average abundance peaked at close to 3 per tow (Fig. 10a). This period appears extraordinary in the context of the entire survey series, and as a result, calculated rates of change in abundance that include this period should be interpreted cautiously. Overall, comparing the most recent decade to the 1970s, there appears to be little change in the abundance of haddock in the survey.

The increase in abundance during the 1980s was accompanied by a large increase in the area occupied by haddock in the September survey. This also coincides with a period when the area occupied and the stock biomass of haddock on the Scotian Shelf were at peak levels (DFO 2002b), suggesting that the patterns observed in the sGSL mainly reflect a density-dependent range expansion. There was an overall 70% decline in area occupied in the sGSL calculated for the most recent six generations of haddock, and a 40% decline over the entire series.

As a result of the low number of individuals captured in the September survey annually, the length-distribution of haddock has been quite variable since 1971 (Fig. 10a,b). Overall, there do not appear to be any long-term trends in length composition.

3.2.9: Pollock (*Pollachius virens*)

Pollock are captured infrequently in the September survey (typically in 1-5% of tows) (Fig. 11a), mainly in the deeper waters of the Laurentian channel (Benoît et al. 2003). Except for 1987 and 1988, the survey abundance index for pollock has been very low. The 75% decline in abundance calculated over the past 3 generations is an artefact of the high 1987 and 1988 values. No change in abundance is evident over the 32-yr time series, except for this brief increase in the late 1980s.

Area occupied by pollock in the September survey has been quite variable since 1971, although a peak during the late 1980s matches the observed peak in abundance. Area occupied and D95 have declined from this peak in the mid to late 1980s but are currently comparable to the average level in the 1970s and early 1980s.

Too few pollock are captured annually to comment on trends in the length-composition of the catch (Fig. 11 b).

3.2.10: Fourbeard rockling (*Enchelyopus cimbrius*)

The distribution of fourbeard rockling in the sGSL in September is bimodal with respect to depth; densities are highest in the shallow waters east of P.E.I. and in St. Georges Bay, as well as in the deep waters of the Laurentian Channel (Benoît et al. 2003).

Fourbeard rockling were rare in the survey prior to the mid-1980s (Fig. 12a). Abundance increased gradually from 1985, reaching a peak in the mid-1990s. The gradual increase in abundance and percent occurrence from 1982 to about 1986 suggests that this was not likely due to an increase in catchability as a result of the vessel and gear change that occurred in 1985. Abundance in the last three years has been lower than the mid-1990s peak, but comparable to levels in the mid to late 1980s. While an overall 30% decline in abundance is calculated over 3 generations of fourbeard rockling, this reflects a decline from the very high values in 1995-1999. Abundance currently appears to be high compared to the 1970s.

Area occupied by fourbeard rockling in the September survey has increased dramatically since the early 1980s, leading to an overall increase of nearly 100% in 20 years. Over this period, the length-composition of this species in the survey has been relatively constant (Fig. 12a,b).

3.2.11: Marlin-spike grenadier (*Nezumia bairdii*)

In the sGSL in September, marlin-spike grenadier occur only along the northern edge of the survey area, in the deep waters of the Laurentian Channel (Benoît et al. 2003). While it is clear that the survey does not cover much of the area occupied by this species, it is consistently captured in sets made in Channel waters.

Abundance of marlin-spike grenadier was relatively low (average, <0.3 per tow) from 1971-1978, but increased gradually from 1979-1987, to an average of about 1.8 per tow (Fig. 13a). The gradual increase in abundance and percent occurrence over this period suggests that this was not likely due to an increase in catchability as a result of the vessel and gear change that occurred in 1985. Abundance remained relatively high until the early 1990s, but has declined continuously since that time. Percent occurrence has also declined, most notably since 1995. Overall, abundance has declined by approximately 60% over the last decade (and last three generations) for this species. In fact, even though there is a fair amount of annual and inter-annual variability in the abundance index for marlin-spike grenadier, there is an overall decline in abundance ranging between 50-60% whether the most recent five or eighteen years are considered. However, the current abundance index for this species is still slightly a little higher than that observed in the early part of the series.

The area occupied by marlin-spike grenadier in the sGSL increased from 1971 to the late 1980s, reaching a high of approximately 6000 km^2. However, since the early 1990s the area occupied has been in decline, reaching below 3000 km^2 in the most recent year. This value is comparable to that observed in the early 1970s. Over the last 20 years, the area occupied has decreased by about 20%. Trends in D95 are quite similar to those observed for the area occupied by the species.

The length-frequency distribution of marlin-spike grenadiers has shifted to progressively smaller sizes over the past twenty years. While the gradual decreases in the median, 75th and 95th percentiles of length largely reflects an increase in the proportion of small individuals (<15 cm), there has also been a slow decrease in the maximum length captured since the early 1990s (Fig. 13b). Individuals measuring more than 30 cm, which were regularly captured in the first two decades of the survey, have been relatively rare in the most recent decade.

Given that the survey area covers only a fraction of the species' habitat, it is impossible to conclude if the patterns presented here reflect a temporary shift in distribution into and out of the sGSL (late 1980s-early 1990s), or actual changes in the status of the species. It is clear that population indicators for marlin-spike grenadier need to be considered on a broader scale before determining the status of this species. While it is premature to speculate on threats to this species, it is worth noting that it has been recorded in by-catch off of Newfoundland and Labrador (Savvatimsky 1989).

3.2.12: Silver hake (*Merluccius bilinearis*)

Silver hake are captured infrequently in the September survey (typically in 1-8% of tows) (Fig. 14a), mainly in nearshore areas and in the deeper waters of the Laurentian channel (Benoît et al. 2003). The survey abundance index has typically been very low, with the exception of the period beginning in 1984, when abundance increased to a peak in 1987 and decreased gradually until about 1992. This period appears extraordinary in the context of the entire survey series, and as a result, calculated rates of change in abundance including this period should be interpreted cautiously. Overall, comparing the most recent decade to the 1970s, there appears to be little change in the abundance of silver hake in the survey.

Except for a spike in 1974, the indices of geographic distribution vary in parallel to the changes in abundance of silver hake. Distribution expanded as abundance increased between the mid-1980s and early 1990s. Area occupied and D95 have declined substantially from the relatively high values of mid 1980s to early 1990s but are currently comparable to the levels that persisted throughout the 1970s.

Too few silver hake are captured annually to comment on trends in the length-composition of the catch (Fig. 14b).

3.2.13: Longfin hake (*Phycis chesteri*)

Longfin hake are consistently captured in the September survey in the waters of the Laurentian Channel (Benoît et al. 2003). Abundance has tended to be relatively low yet constant in the survey series (Fig. 15a). The relatively high abundance in 1990 stems from a single large tow and is likely not representative of true abundance. Overall there has been little or no long-term change in the abundance of longfin hake.

The area occupied by longfin hake increased after 1980, reaching a peak in 1985, coincident with a peak in abundance. While an overall decline in area occupied of about 30% is calculated for the past 20 years, this results from this peak and is probably not a reflection of a change in the status of longfin hake.

Given the relatively small number of longfin hake captured annually, the length distribution varies somewhat from year to year (Fig. 15a,b). Despite this variability, there appears to be a gradual shift towards smaller sizes since about 1985. This is due to a shift in modal length, rather than an influx of small individuals. With the exception of 1998 when the survey captured a very large longfin hake, possibly a mis-identified white hake, the maximum length of individuals captured has generally declined as well.

3.2.14: White hake (*Urophycis tenuis*)

The distribution of white hake in the sGSL in September is bimodal with respect to depth; densities are highest in shallow inshore waters and in the deep waters of the Laurentian Channel (Benoît et al. 2003). The directed fishery for this species in NAFO Div. 4T has been under moratorium since 1995.

The abundance of white hake in the September survey was relatively high during much of the 1970s and 1980s, but has been at a very low level in most years since about 1993 (Fig. 16a). The relatively high abundance in 2000 was the result of a few sets in the Cape Breton trough that captured a large number of intermediate sized white hake (DFO 2003a). Despite the inclusion of these sets in the calculation, there is an overall 60% decline in abundance over three generations of white hake.

The area occupied by white hake in the September survey area has been declining steadily since the mid-1980s, and is currently lower than the values observed during a previous period of low abundance in the early 1970s. Over the past 6 generations of white hake, this represents a greater than 50% decline. The change in D95 has closely mirrored this pattern, indicating a steady contraction of range over the past 20 years.

The length distribution of white hake has been progressively shifting toward smaller lengths since about 1980 (Fig. 16a,b). This is mainly due to a progressive shift in the modal length over the years, as well as a dramatic decrease in the maximum length captured in the survey since 1985 (changing from over 100 cm to about 60 cm in the most recent years). In contrast, the temporary shift toward smaller lengths observed in the mid-1970s was mainly due to a large increase in the proportion of small individuals.

It is clear that the overall status of white hake in the sGSL is of concern given the downward trends in all of the indicators discussed above. Even in the absence of a commercial fishery, the most recent stock assessment advice suggests that rebuilding of the population is unlikely in the short to medium given the currently very low levels of recruitment and high overall mortality (Hurlbut and Poirier 2001).

3.2.15: Threespine stickleback (*Gasterosteus aculeatus aculeatus*)

The threespine stickleback is a euryhaline species that is broadly distributed across the coastal Atlantic and Pacific waters of Canada (Scott and Crossman 1973), with the sGSL representing a small fraction of its distribution in Canada. In September, they are found throughout the sGSL in waters less than 100 m in depth (Benoît et al. 2003).

The abundance of threespine sticklebacks in the September survey has generally increased since 1985 (Fig. 17a), resulting in an approximate 180% increase in the last decade. This trend is most striking when considering percent occurrence, which may be a more appropriate indicator of abundance given the apparent low and variable catchability of this species to the survey gear. As this is not an exclusively nearshore species, the addition of nearshore strata in 1984 does not appear to unduly affect the abundance index or percent occurrence, and cannot explain why sticklebacks were rarely captured prior to that time. Furthermore, given that the increase in abundance since 1985 has been gradual, it does not suggest that this is merely due to an increase in catchability resulting from the gear and vessel change that occurred that year.

Concomitant with the apparently large increase in abundance, there has been a continuous increase in the area occupied by this species in the sGSL since 1985. Over the last twenty years this represents more than a 1,000% increase. D95 has also increased steadily since 1985, indicating a steady expansion of geographic range.

There are no discernible trends in the length composition of threespine sticklebacks captured in the September survey (Fig. 17b).

3.2.16: Monkfish/goosefish (*Lophius americanus*)

Although monkfish are captured almost every year in the deep waters of the September survey area, the occurrence and number captured in any given year are very low (Fig. 18a). As a result there is considerable inter-annual variability in all indices of population status and distribution. Although we calculated a decline in abundance of about 80% over three generations, this is influenced largely by a few recent years where no monkfish were captured. Overall we cannot discern any significant trends in abundance given the inter-annual variability in abundance.

While there is an indication that the area occupied by the species in the sGSL may have decreased by about 40% in the last six generations, the inter-annual variability in that metric along with the limited coverage of monkfish habitat by the survey preclude us from making any conclusions.

Too few monkfish are captured annually to comment on trends in the length-composition of the catch (Fig. 18b).

3.2.17: Atlantic hagfish (*Myxine glutinosa*)

Atlantic hagfish is a demersal species commonly found in the relatively deeper waters of the Laurentian Channel (Benoît et al. 2003).

Although the abundance of Atlantic hagfish was at relatively low level prior to 1995, it increased dramatically in the late 1990s, with an increase of about 500 % over the past decade (Fig. 19a). Frequency of occurrence and indices of distribution were at intermediate levels in the early to mid 1980s, low levels in the early 1990s, and high levels since the mid 1990s. Area occupied has increased by over 250 % over the past 20 years.

There is a large amount of variability in the length composition of Atlantic hagfish in the survey, although smaller individuals (< 30 cm) were more frequently captured in the early 1980s (Fig. 19a,b).

3.2.18: Capelin (*Mallotus villosus*)

The distribution of capelin in the September survey was generally restricted to areas off of the Gaspé peninsula and the western shore of Cape Breton Island from 1971 to the mid-1990s, but has expanded throughout the sGSL since then (Benoît et al., 2003).

The abundance of capelin in the September survey has generally increased since the early 1990s (Fig. 20a), resulting in an increase of about 400% over the last three generations of the species. This trend is most striking when considering percent occurrence, which may be a more appropriate indicator of abundance given the apparent low and variable catchability of this species to the survey gear. Given that there has been a steady increase in occurrence since 1985 and the greatest increases in abundance have been since 1995, these changes clearly cannot be attributed to the vessel/gear changes in 1985 and 1992.

Concomitant with the apparently large increase in abundance, there has been a continuous increase in the area occupied by this species in the sGSL since 1985. Over the last six generations this represents more than a 1,400% increase.

There has been a slightly decreasing trend in the modal length of capelin captured in the September survey over the past two decades (Fig. 20b). This reflects mainly a large proportion of smaller individuals (8-13 cm), which would be expected for a rapidly growing population.

3.2.19: Rainbow smelt (*Osmerus mordax mordax*)

Rainbow smelt is an anadromous species captured mainly in the coastal waters of the southern portion of the survey area in September (Benoît et al. 2003). This species supports a commercial and recreational fishery in the sGSL (Scott and Scott 1988).

Some relatively high mean abundances of rainbow smelt were recorded during the early 1970s, as a result of a small number of very large catches (Fig. 21a). Abundance peaked again during the mid-1980s, and has been at intermediate levels ever since, increasing by over 150% in the past decade. Area occupied has tended to increase somewhat over the time series, though D95 has fluctuated around a constant level.

The length distribution of rainbow smelt in the survey varied without trend until about 1985, but appears to be gradually shifting to smaller sizes since then (Fig. 21a,b). This does not appear to be the result of an increase in the proportion of smaller individuals nor a decrease in the maximum length captured.

3.2.20: Northern sand lance (*Ammodytes dubius*)

Northern sand lance were rarely captured in the September survey prior to the mid-1990s (Fig. 22a). Since that time they have been captured with increasing frequency, particularly in the waters between the Gaspé peninsula and the Magdalen Islands (Benoît et al. 2003). Northern sand lance have been captured too infrequently to comment on trends in length-composition (Fig. 22b).

3.2.21: Northern wolffish (*Anarhichas denticulatus*)

Northern wolffish are rarely captured in the September survey and little can be said about trends in status indicators for the sGSL (Fig. 23a,b). It is worth noting that this species is designated as a threatened species by COSEWIC as a result of population declines in the main areas it inhabits (see Simpson and Kulka 2002 for an overview of the status of this species).

3.2.22: Striped Atlantic wolffish (*Anarhichas lupus*)

Striped Atlantic wolffish are captured annually in a small percentage of tows (Fig. 24a) particularly off Miscou and the Gaspé peninsula, along the slope of the Laurentian channel and in the Cape Breton Trough (Benoît et al. 2003). Their abundance in the sGSL appeared to be relatively high during the late 1980s and early 1990s. Abundance has decline since that time, reaching levels comparable to those observed during the first 15 years of the survey. Over three generations, we calculated an overall increase in striped Atlantic wolffish abundance, but this result is influenced largely by the relatively high abundances of the late 1980s and early 1990s.

The area occupied by striped Atlantic wolffish during the past fifteen years has been somewhat greater than during the first part of the series, although the increase over the past 20 years has been small.

Too few striped Atlantic wolfish are captured annually to say much about trends in the survey length frequency, other than to note a relatively higher proportion of small individuals captured over the past 15 years, leading to a decrease in median length (Fig. 24a,b).

3.2.23: Wrymouth (*Cryptacanthodes maculatus*)

Wrymouth are generally captured in Chaleur Bay and off the eastern end of P.E.I. in September (Benoît et al. 2003). They were captured in the survey once in 1973 and annually since 1980, with the exception of 2000 (Fig. 25a). Abundance in the survey was relatively high from 1981 to 1983, and has been at a lower yet stable level since then. Aside from an increase during the high abundance period in the early 1980s, area occupied by wrymouth in September has been relatively constant. Although we calculated a greater than 50% decline in area occupied over 20 years, this is entirely due to the high levels of 1981-1983 and does not represent a general trend.

The wrymouth captured in the early 1980s were generally small individuals, but the length distribution in the survey since that time has varied without trend (Fig. 25a,b).

3.2.24: Cunner (*Tautogolabrus adspersus*)

Cunner are generally captured in the nearshore waters around P.E.I. and Miscou in September (Benoît et al. 2003). They were captured in approximately half of the years from 1971-1984, and annually since then (Fig. 26a). Given their inshore distribution, the addition of strata 401-403 in 1984 resulted in higher values of abundance and occurrence for cunner, although overall trends in the time series including and excluding these strata are very similar. Although abundance indices are somewhat variable, there was an overall increasing trend during the 1990s and up to 2002; a close to 300% increase over the last decade.

The area occupied by cunner in September varies somewhat from year to year, although there is an increasing trend since the early 1980s (greater than 80% in 20 years). The length distribution of cunner in the survey has varied without trend, as high proportions of small individuals are captured in certain years (Fig. 26a,b).

3.2.25: Atlantic mackerel (*Scomber scombrus*)

Atlantic mackerel are typically captured in nearshore areas in the sGSL during the September surveys (Benoît et al. 2003). Given their more pelagic distribution and relatively high swimming speed, catchability of mackerel to the survey gear tends to be quite variable. This is reflected in the survey abundance index (Fig. 27a), which has fluctuated without any noticeable trends since 1971 (note that the relatively high abundance in 2002 is the result of one very large catch). Percent occurrence, which may be a more appropriate indicator of abundance given the issue of catchability, also does not suggest any long-term trends in abundance. The same is true of the area occupied by mackerel in the September survey area, as well as the length-composition of catches (Fig. 27a,b), both of which show considerable inter-annual variability.

3.2.26: Fourline snakeblenny (*Eumesogrammus praecisus*)

Fourline snakeblenny are currently captured throughout the sGSL in September (Benoît et al. 2003). They were captured infrequently and in small numbers prior to 1985 and much more frequently after 1985 (Fig. 28a), suggesting a likely effect of the vessel and gear change or the switch to 24 hr fishing that occurred that year. The latter is quite likely as Benoît and Swain (2003a, *in press*) estimate that night-time catches are approximately 5-40 times larger (depending on body size) than daytime catches, and the probability of capture is about three times greater at night. So even though corrections for diel effects on catchability are applied to the post-1985 night-time catches, these corrections do not fully compensate for the large difference in the likelihood of capturing fourline snakeblenny. As a result, we concentrate our interpretation only on data collected from 1985 onward.

Since 1985, abundance of fourline snakeblenny has varied with very little trend. The same is true of the area they occupy in September as well as their annual length distribution (Fig. 28a,b).

3.2.27: Daubed shanny (*Leptoclinus maculatus*)

In recent years, daubed shanny have occurred throughout the southwestern Gulf of St. Lawrence and east of P.E.I. (Benoît et al. 2003).

Although daubed shanny were rarely captured prior to 1992, their abundance in the September survey has increased dramatically since then, resulting in an increase of over 1300 % in the last decade (Fig. 29a). Concomitant with this important increase in abundance, there has been a dramatic increase in the area occupied by this species in the sGSL, although this trend may have levelled in recent years. The overall increase in area occupied in the past two decades has been greater than 1700%.

With the exception of a few large individuals (>35 cm) captured in 1989, the length-frequency of daubed shanny in the survey has varied without trend over the past decade (Fig. 29a,b).

3.2.28: Slender eelblenny (*Lumpenus fabricii*)

Slender eelblenny were only captured once in the September survey prior to 1997 (Fig. 30a). They were captured with increasing frequency from 1997 to 2000, although this trend had reversed in 2001 and 2002. Most captures occurred off of Miscou and west of Cape Breton Island (Benoît et al. 2003). Slender eelblenny have been captured too infrequently to comment on trends in length-composition (Fig. 30b).

3.2.29: Snakeblenny (*Lumpenus lampretaeformis*)

Snakeblenny is a species captured mainly in the waters along the Gaspé peninsula and east of P.E.I. in September (Benoît et al. 2003).

The abundance index for snakeblenny has been somewhat variable over the survey series (Fig. 31a). Recent levels have been among the highest observed, although this is largely influenced by a few large sets. Percent occurrence, which is insensitive to the size of catches, has been at an intermediate level in recent years, following a period of higher occurrence during the mid-1990s. The area occupied by snakeblenny in the sGSL in September varies somewhat from year to year, with recent levels comparable to those observed during the first twenty years of the survey.

The length-frequency of snakeblenny in the survey has varied considerably from year to year but without any discernible trends (Fig. 31a,b).

3.2.30: Arctic shanny (*Stichaeus punctatus punctatus*)

Usually living in more northern waters, Arctic shanny were not captured in the September survey prior to 1996, but have been captured in small numbers annually since then (Fig. 32). As a result, we are unable to make any statements on the general status of this species in the sGSL.

3.2.31: Radiated shanny (*Ulvaria subbifurcata*)

Radiated shanny are sporadically captured in the September survey. Aside from a few years during the late 1980s when percent occurrence of radiated shanny was higher, there are no discernible trends in abundance or distribution from the survey (Fig. 33a,b). Too few radiated shanny were captured in the sGSL to comment on trends in the length-composition of this species.

3.2.32: Butterfish (*Peprilus triacanthus*)

Preferring warmer shallow waters, butterfish are only sparingly captured in the sGSL, which is at the northern limit of its range (Benoît et al 2003; Scott and Scott 1988).

Butterfish did not occur in the survey prior to 1984 (Fig. 34a). The abundance index for this species has varied without trend since then. The same is true for the area they occupied in September. Furthermore, too few butterfish are captured during the September survey to comment on trends in the length composition (Fig. 34b).

3.2.33: Fish doctor (*Gymnelus viridis*)

Fish doctor were not seen in the September survey prior to 1985, but have been captured on the Magdalen shallows (Benoît et al. 2003) in most years since then (Fig 35a). Although the abundance index for fish doctor is somewhat variable, there is a discernible trend towards increasing abundance during the early to mid-1990s, with a subsequent rapid decline after 1999. This trend is mirrored in the area occupied by the species in the sGSL in September. Current levels of abundance and distribution are above those observed prior to the dramatic increase in the 1990s. The length composition of fish doctor catches has varied little since 1991 (Fig. 35b).

3.2.34: Unseparated Eelpouts (*Lycodes* sp.)

Eelpouts are found throughout the sGSL in September (Benoît et al. 2003). Although their abundance showed considerable inter-annual variability during the 1970s, this tendency changed during the early 1980s leading to much lower frequency variability thereafter (Fig. 36a). Abundance was relatively low in 1985, but increased gradually to a peak in 1990, declining ever since. Over the past 10 years this represents a greater than 60% decline, with current abundances at levels similar to 1985. Given the variability in the abundance index during the 1970s, it is difficult to establish a baseline level of abundance for this species. Consequently, we cannot determine if it was the relatively high abundance during the early 1990s or the current low abundance that is out of the ordinary. This problem is further compounded by our inability to accurately distinguish the population dynamics of the various species that comprise the genus *Lycodes* in the September survey.

The area occupied by eelpouts in the September survey area generally increased from 1971 to the early 1990s, resulting in a greater than 40% increase over 20 years. However, there is an indication since about 1995 that area occupied may be decreasing.

The length distribution of eelpouts in the survey has been progressively shifting toward smaller sizes since 1980 (Fig. 36a,b). This is generally a result of a combination of a shift in the modal length captured and an increasing proportion of small-bodied individuals captured. The maximum length of individuals in the survey varies from year to year, but does not show any long-term trends.

Overall, the indicators of population status for eelpouts in the sGSL suggests that some or all of the species in the genus *Lycodes* captured in the September survey may be declining. Our inability to confidently and consistently distinguish these species is of concern given that many of them are found on the COSEWIC priority list (see Table 2).

3.2.35: Atlantic softpout (*Melanostigma atlanticum*)

Atlantic softpout were not seen in the September survey prior to 1985, although they have subsequently been captured with increasing frequency (Fig. 37a) in the relatively deep waters of the Laurentian Channel (Benoît et al. 2003). The gradual increase in abundance and percent occurrence suggests that this is not likely due to an increase in catchability as a result of the vessel and gear change that occurred in 1985. Over the past decade, abundance of Atlantic softpout has increased by over 850%. This has been accompanied by a gradual expansion in area occupied, representing a greater than 400% increase over the past 20 years.

There are no discernible trends in the length composition of Atlantic softpout captured in the September survey (Fig. 37a,b).

3.2.36: Common ocean pout (*Zoarces americanus*)

Common ocean pout occur mainly in the waters surrounding Miscou and P.E.I. in September (Benoît et al. 2003). Their abundance has varied generally without trend over the survey series (Fig. 38a). High levels of abundance in 1982,1983 and 1987 greatly influence the estimated 90% decline calculated over 3 generations. Such a large decline is not evident in the percent occurrence of this species.

The area occupied by common ocean pout in the survey area has varied between about 2000 to 17000 km^2 since 1971. Over the past 6 generations an overall decline of over 50 % is calculated, although this is entirely influenced by the high levels observed in 1982 and 1983.

The length composition of common ocean pout in the annual survey has varied without trend since 1971 (Fig. 38a). A higher proportion of small individuals (<25 cm) has been observed approximately every five years (Fig. 38b).

3.2.37: Witch flounder (*Glyptocephalus cynoglossus*)

Witch flounder in the entire Gulf of St. Lawrence is considered a single stock (NAFO div. 4RST), supporting a 1,000 tonne fishery in recent years. In the September survey, they are typically found in the Laurentian channel and along the western shore of Cape Breton Island, although this distribution also extended onto the western portion of the Magdalen shallows during the first 20 years of the survey (Benoît et al. 2003). Given that a large portion of the witch flounder population occurs outside of the survey area, sources including survey information from both the southern and northern Gulf of St. Lawrence should be consulted in determining overall status (DFO 2003b).

The abundance of witch flounder in the September survey has varied on roughly a decadal time-scale, with a period of intermediate abundance during the 1970s, low abundance during the early 1980s, and high abundance in recent years (Fig. 39a). Overall, there has been close to a 500% increase in abundance in the 4T portion of the management unit over the past 3 generations of witch flounder.

The area occupied by witch flounder in the September survey area is somewhat variable from year to year, but has been declining somewhat. Over the past 20 years, the decline has been on the order of 20%. Over this period there has been a much sharper decline in D95 (approximately 50%) suggesting that witch flounder are becoming increasingly spatially aggregated.

The length distribution of witch flounder in the September survey has been progressively shifting to smaller sizes since the mid-1980s (Fig. 39a,b). This is largely due to a shift in modal length rather than an influx of small individuals. The maximum length in the survey has declined since the early 1990s.

3.2.38: American plaice (*Hippoglossoides platessoides*)

American plaice are broadly distributed throughout the sGSL in September (Benoît et al. 2003). In most years from 1965 to the mid-1980s this population supported an 8,000-10,000 tonne fishery. However, this fishery has been limited to between 1,000 and 2,500 tonnes in the most recent decade (DFO 2003c).

The abundance of American plaice in the survey was relatively low during the early 1970s, but rapidly increased four-fold to a peak in 1977, followed by an equally dramatic decline until 1984 (Fig. 40a). There was a slight recovery from 1985 to 1991, but abundance has been in continuous decline since then. The abundance indices for the three most recent years are the lowest on record for this species in the sGSL. There has been a nearly 70% decline in plaice abundance over 3 generations.

Despite the large decrease in abundance, American plaice is currently the mostly widely distributed species in the sGSL, with percent occurrence in the 85-90% range in most years of the time series. The area occupied by American plaice in the sGSL in September is large and has been relatively constant over the survey time series. On the other hand, D95 has been steadily increasing since the early 1980s, with close to a 40% increase in 20 years. Combined with the constant area occupied, this suggests that the distribution of plaice is becoming more diffuse over time. While plaice were heavily concentrated in the western portion of the sGSL during the 1970s and early 1980s, an increasing proportion are now found in the eastern half (Benoît et al. 2003). In fact, it appears that that most if not all of the declines in American plaice abundance since 1977 have occurred in the western half of NAFO division 4T (DFO 2003c).

There has been a slight, yet progressive, shift towards smaller sizes in the length distribution of American plaice in the September survey since the mid-1980s (Fig. 40a,b). This stems from a shift in modal length as well as an increase in the proportion of small individuals. The maximum length in the survey has declined from close to 65 cm in the early 1980s to close to 55 cm in recent years.

3.2.39: Atlantic halibut (*Hippoglossus hippoglossus*)

Atlantic halibut is considered to comprise a single stock over the entire Gulf of St. Lawrence (NAFO div. 4RST), supporting an approximate 200 tonne fishery in recent years (DFO 2003d). Given that a large portion of the Atlantic halibut population occurs outside of the survey area, sources including survey information from both the southern and northern Gulf of St. Lawrence should be consulted in determining overall status (DFO 2003d).

Atlantic halibut were almost never captured in the survey prior to 1984, but have been captured at a low frequency and in small numbers since then (Fig. 41a). Abundance in the survey appears to be increasing since 1997, with an overall three-orders of magnitude increase over three generations. A similar increasing trend is noted in the percentage of tows capturing halibut and in area occupied. The latter has increased by over 500% over 20 years.

Too few Atlantic halibut are captured annually to comment on trends in the length-composition of the catch, other than to note that small individuals (<30 cm) have been captured in many years during the 1990s (Fig. 41b).

3.2.40: Yellowtail flounder (Limanda ferruginea)

Yellowtail flounder are concentrated in shallow inshore areas of the sGSL in September (Benoît et al. 2003). This species has supported an approximate 200-300 tonne fishery in recent years (DFO 2003e).

Following a period of relatively low abundance during the early to mid-1970s, yellowtail flounder abundance in the September survey has been relatively stable at a higher level, increasing slightly over the past three generations (Fig. 42a). The area occupied by this species has varied somewhat over the survey series, and has been at a relatively high level over the past 5 years.

The length distribution of yellowtail flounder in the September survey has been progressively shifting to smaller sizes, most notably since the mid-1980s (Fig. 42a,b). This is largely due to a shift in modal length rather than an influx of small individuals. The maximum length in the survey has generally varied without trend for most of the series, although the four lowest values were recorded in the most recent four years.

3.2.41: Winter flounder (*Pseudopleuronectes americanus*)

Winter flounder are concentrated in shallow inshore areas of the sGSL in September (Benoît et al. 2003) and it is likely that much of their habitat, particularly that of smaller individuals, may not be covered by the survey (DFO 2003f). This species has supported an approximate 400-600 tonne fishery in recent years (DFO 2003f).

The abundance of winter flounder in the September survey has varied without trend over much of the period since 1971 (Fig. 43a). The area occupied by this species has varied somewhat with a slightly increasing trend over most of the time series.

The length distribution of winter flounder in the September survey has been progressively shifting to smaller lengths since 1971 (Fig. 43a,b). This is due to a shift in modal length, an increasing proportion small individuals and a tendency toward smaller maximum lengths in the survey.

3.2.42: Greenland halibut (*Reinhardtius hippoglossoides*)

The distribution of Greenland halibut in the sGSL in September is mainly in the deeper waters off of the Gaspé peninsula, in the Laurentian channel and in the Cape Breton trough. Greenland halibut in the entire Gulf of St. Lawrence is considered a single stock (NAFO div. 4RST), supporting an approximate 1,000-4,000 tonne fishery in recent years (DFO 2003g). Given that a large portion of the Greenland halibut population occurs outside of the survey area, sources including survey information from both the southern and northern Gulf of St. Lawrence should be consulted in determining overall status (DFO 2003g).

Greenland halibut were captured at a very low frequency and in small numbers in the survey prior to about 1985 (Fig. 44a). Abundance reached intermediate levels from 1985-1987 and again from about 1991-1997, and has been at very high levels since 1998. Over three generations this represents an increase of over five orders of magnitude.

The area occupied by Greenland halibut in September has generally been increasing since 1971, with an overall increase of over 130% over 20 years. On the other hand, D95 has increased much more slowly, indicating that the recent increase in abundance has not resulted in an expansion of range.

The length distribution of Greenland halibut in the September survey is quite variable from year to year, but there appears to be a slight, yet progressive, shift toward smaller lengths since 1971 (Fig. 44a,b). This is due mainly to a shift in modal length and the occasional increased proportion small individuals. Interestingly, the survey appears to consistently track modes in the length distribution from one year to the next as the fish grow. The maximum length of individuals captured in the survey has generally varied without trend since 1971.

3.2.43: Windowpane (*Scophthalmus aquosus*)

Historically known for occurring mostly around Magdalen Islands in the sGSL (Scott and Scott 1988), windowpane was generally captured in the Northumberland Strait and St-Georges Bay in September (Benoît et al 2003).

Windowpane were captured in most years from 1971-1984, and annually since then (Fig. 45a). Approximately one-quarter of all windowpane catches are made in strata 401-403. However, there are no discernible trends in abundance for either survey abundance series (with and without these inshore strata). The estimated 20% decline in abundance over 3 generations is influenced entirely by the relatively low abundance in the two most recent years. Percent occurrence in these two years was not unusually low.

The area occupied by windowpane in September has varied somewhat from year to year, although an increasing trend of about 50% is evident over the past 6 generations. The length-frequency of windowpane in the survey has varied without trend (Fig. 45a,b).

3.2.44: Thorny skate (*Amblyraja radiata*)

Thorny skate were broadly distributed throughout the sGSL in September during the early part of the survey series but are now restricted to the deeper waters of the Laurentian Channel and the Cape Breton trough (Benoît et al. 2003). Abundance of thorny skate during the 1970s varied from year to year but was generally relatively high (Fig. 46a). A relatively low level of abundance was observed in the mid-1980s, however the population increased to a high level in the late 1980s. There has been a decreasing trend in abundance since the mid-1990s however. We estimate an overall decline in abundance of about 20% over what we estimate to be the three most recent generations of thorny skate. Over the most recent 10 years, the decline is much more pronounced (50%).

The area occupied by thorny skate in September varied without trend through much of the 1970s and 1980s, but has been declining dramatically since about 1990. Over 20 years this represents a close to 50% decline. A similar trend in D95 indicates a dramatic contraction in geographic range of thorny skate in the sGSL in the 1990s.

The length distribution of thorny skate in the September survey progressively shifted to smaller lengths throughout the 1980s (Fig. 46a,b). This trend appears to have levelled in recent years. The decreasing trend in the 1980s was due to a decrease in the number of larger individuals captured and an increase in the number of small ones (D.P. Swain, *unpublished analyses*). There has been a steady decline in the maximum length of thorny skate in the survey since the mid-1980s, from about 75 cm to below 65 cm.

In assessing the status of thorny skate in the sGSL it is important to note that the increase in abundance of thorny skate in the late 1980s is entirely of small fish. These fish do not seem to be recruiting to larger size classes, suggesting high mortality (or very slow growth). Dramatic declines in the abundance of large (mature) skates, recent declines in the abundance of small skates and the dramatic contraction in geographic range in the sGSL in the 1990s suggest that the status of thorny skate throughout Canadian waters merits closer attention.

3.2.45: Winter skate (*Leucoraja ocellata*)

Winter skate tend to be distributed in the shallow inshore waters of the sGSL, and occasionally on Bradelle and Orphan's Banks, in September (Benoît et al. 2003). Although we present an overview of the status of winter skate in the sGSL, a more comprehensive review of the status of this species throughout Atlantic Canada is available in Simon et al. (2003).

Abundance of winter skate in the September survey has generally been declining since the mid- 1970s, leading to an overall decline on the order of 80-90% over three generations (Fig. 47a). The area occupied by this species in the sGSL in September varies from year to year, but appears to have generally increased from the early 1970s to the mid-1980s, declining continuously ever since. Over the past 20 years this represents more than a 50% decline.

The length distribution of winter skate in the September survey has progressively shifted to smaller lengths since the early 1980s (Fig. 47a,b). This trend was mainly due to a dramatic decrease in the number of larger individuals captured (D.P. Swain, *unpublished analyses*). Although the maximum length of winter skates captured in the survey has been relatively constant over the past decade, these values are a little lower than those observed in the mid to late 1980s.

3.2.46: Smooth skate (*Malacoraja senta*)

In September, smooth skate tend to be distributed in the relatively deep waters of the Laurentian Channel and in the Cape Breton Trough, although they were occasionally caught in inshore areas around P.E.I. and south of the Magdalen Islands (Benoît et al. 2003).

The abundance of smooth skate in the survey varied somewhat from year to year during the 1970s, reaching a low level in the early 1980s, followed by an increase to higher levels from the mid-1980s to the mid-1990s (Fig. 48a). Abundance appears to have declined over the past 5 years, although no long-term trends in abundance are evident over the survey time series. The area occupied by smooth skate in September shows considerable inter-annual variability, although there appears to be a long-term increasing trend of close to 20% over 20 years. This reflects the relatively wide distribution since 1985 compared to the 1975-1985 period.

The length distribution of smooth skate in the September survey has progressively shifted to smaller lengths since the late 1987s (Fig. 48a,b). This trend was mainly due to an increase in the number of smaller individuals captured (D.P. Swain, *unpublished analyses*). The maximum length of individuals captured has generally varied without trend over much of the survey series.

3.2.47: Alligatorfish (*Aspidophoroides monopterygius*)

Alligatorfish are broadly distributed throughout the sGSL in September (Benoît et al. 2003). They were captured at low frequency and in small numbers prior to 1985 and much more frequently since then (Fig. 49a). The gradual increase in percent occurrence and, to a lesser extent abundance, from 1985 to the late 1990s does not suggest that this is a result of a change in catchability stemming from the 1985 vessel and gear change. Over the past decade, abundance of alligator fish has increased by approximate 40%. The area occupied by alligatorfish in September has expanded continuously since 1985, resulting in a 250% increase over 20 years.

The length composition of alligatorfish in the survey has varied without trend over the past fifteen years (Fig. 49a,b). The unusually large (>20 cm) alligatorfish observed in the 1970s and early 1980s may very likely be mis-identified Atlantic sea poacher given the morphological similarity between the two species. Unfortunately we are unable to confirm this mistake and have left these individuals as alligatorfish. Nonetheless given the relatively small number of fish involved and recent trends towards dramatic increases in abundance, this possible taxonomic error does not affect our interpretation of the status of either species.

3.2.48: Atlantic sea poacher (*Leptagonus decagonus*)

In recent years, Atlantic sea poacher has mainly been captured off of Gaspé and on the Magdalen shallows in September (Benoît et al. 2003).

Aside from one occurrence in 1981, Atlantic sea poacher were apparently not captured in the September survey prior to 1985 (see section 3.2.47, alligatorfish, for possible exceptions) (Fig. 50a). The abundance of this species has gradually increased since 1985, resulting in an increase of over 200% over the last decade. The gradual increase in both abundance and percent occurrence does not suggest that this is a result of a change in catchability stemming from the 1985 vessel and gear change.

Concomitant with the increase in abundance, there has been a continuous increase in the area occupied by this species in the sGSL since the mid-1980s. Over the last twenty years, this represents more than a 650% increase.

Over the past decade, the length distribution of Atlantic sea poacher has shifted to progressively smaller sizes (Fig. 50a,b). The gradual decreases in the median, 75th and 95th percentiles of length largely reflect an increase in the proportion of smaller individuals (<10 cm).

3.2.49: Arctic hookear sculpin (*Artediellus uncinatus*)

Arctic hookear sculpin are currently found throughout the sGSL in September (Benoît et al. 2003). They were captured infrequently and in small numbers prior to 1985, and captured annually since then (Fig. 51a). The gradual increase in percent occurrence from 1985 to 1995 does not suggest that this is a result of a change in catchability stemming from the 1985 vessel and gear change. Aside from a few relatively large abundance levels in the late 1980s and in 1991, abundance of this species has varied with very little trend overall since the mid-1980s. However, the area occupied by Arctic hookear sculpin in September has increased by more than 300 % since 1985. Over that time period, the length composition of this species in the survey has varied generally without trend (Fig. 51a,b).

3.2.50: Arctic staghorn sculpin (*Gymnocanthus tricuspis*)

Usually confined to the cold waters off the Labrador coasts and in the Arctic seas, a small number of Arctic staghorn sculpin have been captured in the sGSL survey since 1992 (Fig. 52a,b). Unfortunately the size and frequency of catches has been too small to make any conclusions on the general status of this species in the area.

3.2.51: Spatulate sculpin (*Icelus spatula*)

Spatulate sculpin were not seen in the September survey prior to 1992, but have been captured in the waters between Gaspé and the Magdalen Islands since then (Benoît et al. 2003). The abundance of this species increased rapidly up to 1997, and may have decreased a little since then (Fig. 53a). Similarly, the area occupied by spatulate sculpin in the sGSL in September increased dramatically from 1992 to 1997, but appears to have levelled in recent years.

Too few spatulate sculpin are captured annually to comment on trends in the survey length-composition other than to note a higher proportion of larger individuals (> 10 cm) captured since 1996 (Fig. 53b).

3.2.52: Longhorn sculpin (*Myoxocephalus octodecemspinosus*)

Longhorn sculpin are commonly found in the shallow areas of the sGSL in September (Benoît et al. 2003). Their abundance in the survey has varied without any marked trend and recent levels have been average for the series (Fig. 54a). The area occupied by longhorn sculpin in the sGSL has varied on approximately a decadal scale, with a moderate increasing trend over the past six generations.

The length composition of longhorn sculpin in the annual survey has varied without any long-term trends (Fig. 54a,b).

3.2.53: Arctic sculpin (*Myoxocephalus scorpioides*)

A small number of Arctic sculpin were captured in the sGSL survey from 1994 to 1998 (Fig. 55a,b). Unfortunately the size and frequency of catches has been too small to make any conclusions on the general status of this species in the area.

It is worth noting that this species, which typically does not grow larger than 21 cm, can be confused with the larger shorthorn sculpin (Scott and Scott 1988). Given the sizes of Arctic sculpin individuals recorded in 1994 and 1997, it is possible that such a misidentification may have occurred. However, in light of the small number of fish involved, this would not affect the status determination for either species.

3.2.54: Shorthorn sculpin (*Myoxocephalus scorpius*)

Shorthorn sculpin are generally captured in the inshore areas around Magdalen Islands, Miscou and P.E.I. in September (Benoît et al. 2003).

Captured in small numbers in most years prior to 1985, Shorthorn sculpin have been captured annually and with increasing frequency since then (Fig. 56a). The gradual increase in percent occurrence since 1985 does not suggest that this is a result of a change in catchability stemming from the vessel and gear change that occurred that year. Abundance of this species has increased gradually over the past two decades, resulting in a 350% increased over three generations. A concomitant continual increase in area occupied is also noted (over 400% in twenty years).

The shorthorn sculpin captured in the survey prior to 1985 were mainly larger individuals (>25 cm) (Fig. 56a,b). The length composition of catches since then has included a larger proportion of smaller individuals, and has generally varied without trend.

3.2.55: Moustache (mailed) sculpin (*Triglops murrayi*)

In recent years, moustache sculpin have been broadly distributed throughout the sGSL in September (Benoît et al. 2003).

Captured in small numbers in most years prior to 1985, moustache sculpin have been captured annually and with increasing frequency since then (Fig. 57a). The gradual increase in abundance and percent occurrence from 1985 to 1995 does not suggest that this is a result of a change in catchability stemming from the vessel and gear change that occurred that year. Abundance declined during the later part of the 1990s, to a low in 2001. Although we calculated a 50% decline in the abundance of moustache sculpin over the past decade, recent levels of abundance are comparable to those observed prior to the increase in the latter part of the 1980s.

The rapid increase in abundance during the 1985-1995 period was accompanied by an important increase in the area occupied by the species (over 100 % in 20 years). Although distribution has contracted a little over the most recent five years, levels are still relatively high.

The length-distribution of moustache sculpin in the survey has varied without any discernible trends (Fig. 57a,b).

3.2.56: Lumpfish (*Cyclopterus lumpus*)

Lumpfish are mainly captured in the waters off of Gaspé in September (Benoît et al. 2003). The abundance of lumpfish in the survey has varied without much of a trend since 1971 (Fig. 58a). Levels in the late 1990s tended to be relatively high, with lower values in the two most recent years. Over the three generations, this has represented an overall 110% increase.

The area occupied by lumpfish in the sGSL survey area has also varied considerably since 1971, fluctuating between less than 1000 to over 7000 km^2. Over the past 6 generations, an overall increase of almost 50% is calculated in the area occupied.

The length composition of lumpfish in the annual survey has also varied considerably, with very little long-term trend (Fig. 58a). A relatively large proportion of small individuals (< 20 cm) has been captured approximately every four or five years since the late 1980s (Fig. 58b).

3.2.57: Atlantic spiny lumpsucker (*Eumicrotremus spinosus*)

Atlantic spiny lumpsucker are broadly distributed throughout the sGSL in September (Benoît et al. 2003).

Aside from one occurrence in 1974, Atlantic spiny lumpsucker were not captured in the survey prior to 1985 (Fig. 59a). Given the very rapid increase in abundance and percent occurrence after 1985, we cannot rule out an increase in catchability associated with the vessel and gear change in 1985. As a result, we concentrate our interpretation only on data collected from 1985 onward. Since then, abundance of Atlantic spiny lumpsucker and the area they occupy in September have varied with little overall trend. The same is true of their length composition in survey catch (Fig. 59a,b).

3.2.58: Sea raven (*Hemitripterus americanus*)

In the sGSL, sea raven occur principally in the shallow waters around P.E.I., the Magdalen Islands and Miscou (Benoît et al. 2003).

The abundance index for sea raven was relatively high for much of the period from 1971 to 1984, decreased steadily to a low in 1992-1993, followed by a steady increase since then (Fig. 60a). This increase over the past decade has been on the order of 200%, although the most recent abundance levels are still below those observed prior to 1990.

The area occupied by sea raven in the sGSL displays a similar trend as abundance, with a period of relatively broad distribution up to the mid-1980s, contracted distribution during the early 1990s, and broadening distribution since then. Although we calculated an overall 20% decline in area occupied over 20 years, recent levels have been average for the series.

The length distribution of sea raven in the September survey varied without trend up to the mid-1980s, but has been progressively shifting to smaller sizes since then (Fig. 60a,b). This reflects largely an increasing proportion of small individuals (< 20 cm), and to a lesser extent, a reduction in the proportion of larger individuals (> 40 cm). Although the maximum length captured varies somewhat annually, the largest individuals since 1985 have been about 10% smaller than those captured prior to that year.

3.2.59: Unseparated Seasnails (*Liparis* spp.)

In September, seasnails are found in the waters between the Gaspé peninsula and the Magdalen Islands (Benoît et al. 2003).

Seasnails were infrequently captured in the September survey prior to 1982, and annually since then (Fig. 61a). The abundance and occurrence of seasnails increased continuously from 1984 to 1995, suggesting that a change in catchability associated with the 1985 vessel/gear change is unlikely. Since 1995, abundance has decreased somewhat, resulting in a 30% decline calculated over 10 years. However, it is important to note that recent values are still well above average for this taxon.

The area occupied by seasnails in the sGSL increased dramatically from the mid-1980s to the mid-1990s. Although this trend reversed somewhat after 1995, recent levels are still well above average. Over the last twenty years, we calculated an approximate 200% increase in area occupied.

Too few seasnails were captured before 1986-1987 to comment on prior trends in length-composition (Fig. 61a,b). Since then, there has been a slight trend towards smaller sizes in the survey resulting from an increasing proportion of small individuals (<10cm) and a decrease in the maximum length captured.

3.2.60: Polar sculpin (*Cottunculus microps*)

Polar sculpin have only occasionally been captured in the September survey (Fig. 62a,b). Too few individuals were caught to assess the general status of this species in the sGSL.

3.2.61: Redfish (*Sebastes* spp.)

Redfish are commonly found in the relatively deeper waters of the Laurentian Channel in September (Benoît et al. 2003). Redfish in the entire Gulf of St. Lawrence are considered a single stock (called Unit 1 redfish, which includes NAFO div. 4RST, 3Pn4Vn – January to May). Although this stock had supported an important fishery at one time, it was put under moratorium in 1995 following a collapse. Only small index and research fisheries have been permitted since then. Given that a potentially large portion of the redfish population occurs outside of the survey area, sources including survey information from both the southern and northern Gulf of St. Lawrence should be consulted in determining overall status (see Morin et al. 2001).

The abundance of redfish in the September survey was at an intermediate level throughout most of the 1970s and 1980s, at a relatively high level towards the end of the 1980s, and has been at a very low level since 1993 (Fig. 63a). Over the last decade, the estimated decline in abundance has been almost 100%. Current levels of abundance are about one order of magnitude smaller than those observed during the first 15 years of the survey.

Despite these dramatic changes in abundance, the area occupied by redfish in the sGSL has changed relatively little over twenty years (20% decline). In fact, the area occupied during the low-abundance period of the 1990s has been greater than that observed during the 1970s. The lack of trend in D95 suggests that the changes in abundance have been spatially uniform. Again, given that a potentially large portion of the Unit 1 redfish population occurs outside of the survey area, trends in distribution need to be interpreted along with data from other surveys.

The length composition of redfish in the September survey has shifted to slightly smaller lengths since the mid-1980s (Fig. 63a). This is largely a result of an increasing proportion of small (<15 cm) individuals (Fig. 63b). The maximum length of redfish captured in the survey has varied without trend since 1971.

3.2.62: Black dogfish (*Centroscyllium fabricii*)

Black dogfish have been captured in the deep waters of the Laurentian channel (Benoît et al. 2003) almost every year since 1976 (Fig. 64a). The abundance index for this species is greatly influenced by the occasional very large catch and may not provide a reliable proxy for actual abundance. Percent occurrence, which provides an indicator of abundance that is insensitive to the occasional large catch, has generally varied with a slightly increasing trend since the early 1980s. Although the area occupied by black dogfish has increased by about 60% over 20 years, this represents a fraction (1,000-2,000 km^2) of the total survey area.

The length-frequency of blackdog fish in the survey has varied without any discernible trends since the mid-1970s (Fig. 64a,b).

3.2.63: Spiny dogfish (*Squalus acanthias*)

Spiny dogfish were not captured in the sGSL survey prior to 1984 (Fig. 65a). Their distribution in September is bimodal with respect to depth; densities are highest in shallow inshore waters and in the deep waters of the Laurentian Channel (Benoît et al. 2003).

The abundance index for this species shows considerable variability as a result of a small number of very large catches. Despite this variability, it appears that abundance generally increased from 1984 to the mid-1990s, and has been declining since then. Although we calculated an overall 80% decline in abundance over the past decade, current abundance levels are still comparable to those seen prior to the population increase in the late 1980s. It is important to note that there is evidence that spiny dogfish throughout the Northwest Atlantic represent a single stock, whose abundance had been increasing dramatically up until the mid-1990s, and showing signs of decline thereafter (McRuer and Hurlbut 1996). It is quite possible that the initial increase then decrease in abundance in the sGSL represented a density-dependent shift into and then out of the area, as is suggested by the plots for occurrence and geographic distribution (Fig. 65a). Consequently, there is a good chance that it was the high abundance levels seen in the early to mid-1990s that was out of the ordinary, not the current population lows.

The length distribution of spiny dogfish has been steadily shifting towards larger sizes since 1985 (Fig. 65a; note that the value for 1984 represents a single individual). This is due to an upward shift in the distribution of lengths, with fewer small and more large individuals (Fig. 65b).

4 Summary and Conclusions

4.1 General status in the sGSL

Based on indicators of abundance, distribution and population size-composition, we have identified nine species that display some signs of declining status in the sGSL. Given that none of these species are endemic only to the area, broader scale analyses of status are necessary. To help in guiding such analyses, we generally group these species into three "priority" levels and briefly summarise the pertinent status indicators, for the sGSL.

4.1.1 Highest priority

Winter skate – With a greater than 80% decrease in abundance over (approximately) three generations, a 50% decline in distribution over 20 years, and a continued decrease in the proportion of large individuals, there is reason for concern about the status of this species in the sGSL. We refer interested readers to Simon et al. (2003) for a general description of the distribution and abundance of this species in Canadian waters. With the results compiled by those authors, it should be relatively easy to establish the status of this species nationally.

White hake – The 60% decrease in abundance over three generations and the 50% decline in distribution over six generations are reasons enough for concern about the status of this species in the sGSL. The continued downward shift in the size distribution and the substantial decrease in maximum size captured since the mid-1980s compound these concerns. This is augmented by the fact that this population, which once supported an important fishery over many years, has not shown any sustained signs of improvement since it was put under moratorium in 1995.

4.1.2 Intermediate priority

Atlantic Cod – As noted previously, the status of this species has already been rigorously assessed for Canadian Atlantic waters (Smedbol et al. 2002). Our assessment for the sGSL is not intended to supplant that work, but merely to provide comparison with all of the other species discussed in this report. In the sGSL, cod abundance has declined by about 80% over three generations, although this is mainly influenced by the unusually high abundance period of the 1980s. Over the entire series, the decline is closer to 20-30%. The real concern regarding the abundance of cod, is the failure of the population to recover over the last decade, despite relatively low levels of fishing. In addition, increasing spatial concentration (decrease in D95 of 40% in 20 years and 20% over the series) makes the population increasingly vulnerable to localised sources of mortality. Furthermore, the ongoing loss of the largest individuals in the population is also of concern. Finally, it is worth noting that there was a directed fishery on cod in the sGSL from 1999 to early 2002.

Thorny skate – Abundance has generally declined by 20% over three generations, although the most pronounced declines have occurred more recently (50% over 10 years). The more modest decline calculated over three generations, is influenced largely by an increase in the abundance of small thorny skates in the late 1980s. It appears however that these individuals have not been recruiting to the larger size-classes, and that the maximum size of thorny skate captured has been declining for over 15 years. Furthermore, the abundance of the small skates has been declining recently, leading to the more pronounced overall declines as of late. The substantial contraction in geographic range in the sGSL during the 1990s and into 2000 is all the more concerning.

American plaice – The abundance of this species has declined continuously for more than 20 years, leading to an overall decrease of 70% over three generations. This decline has occurred mainly in the western portion of NAFO 4T, leading to an increasingly more spatially uniform distribution. This latter point is in contrast to the majority of species which show increased spatial aggregation as abundance decreases (MacCall 1990). Along with the decrease in abundance, there has been a constant decrease in the length-composition of plaice and maximum size captured in the survey since the mid-1980s. It is worth noting that at the time this report was printed, a decision to close the American plaice fishery in the sGSL had not been made.

Redfish – The sGSL covers but a small portion of the Unit 1 redfish distribution, nonetheless we felt that the trends in abundance for this genus were of sufficient concern to include them as intermediate priority. Abundance has decreased by about 100% in 10 years and recent levels of abundance are about one-tenth the levels observed during the first fifteen years of the survey. The substantial decrease in sGSL survey abundance is consistent with survey trends for the other areas inhabited by this stock (Morin et al. 2001). This broader scale analysis also shows that the stock became more concentrated in the Cabot Strait area (NAFO divisions 4R and 3Pn) as abundance declined. Only small index and research fisheries remain on this stock.

4.1.2 Lower priority

Marlin-spike grenadier – The situation for this species is somewhat analogous to that of cod. Over 10 years, the abundance of marlin-spike grenadier has declined by about 60%, although this is mainly influenced by a high abundance period during the late 1980s and early 1990s. Current abundance levels are still somewhat higher than those observed during the 1970s. Area occupied shows a similar trend. A broader scale analysis is needed to determine if it was the high abundance period of 1985-1995 or the current lower abundance period that is out of the ordinary.

Eelpouts – The situation for this genus is also somewhat analogous to that of cod and marlin-spike grenadier. Abundance has decreased by about 60% over the past decade, although recent levels are comparable to those observed during the mid-1980s. It is unclear which is out of the ordinary, the current low levels or the higher levels during the early 1990s. This problem is further compounded by our inability to confidently determine the individual status for each of the species that comprise this genus in the sGSL. Nonetheless, the continuous decline in abundance over the past decade suggest that an increased effort needs to be directed at distinguishing as many individual *Lycodes* species as possible during future surveys.

Witch flounder – Clearly this species is not in imminent danger of extirpation from the sGSL given that recent abundance levels are the highest on record. However, downward trends in spatial distribution and size-composition suggest that this species should be monitored closely. 4RST witch flounder remain abundant only in the eastern portion of their distribution (DFO 2003b) and are becoming increasingly spatially aggregated in that area. The length-composition in the sGSL has progressively shifted to smaller sizes over the past fifteen years as fewer large individuals are captured, and the maximum length captured has declined by about 10% over the past decade. On the other hand, there are indications of strong recruitment in neighbouring areas which may be the source of the adult witch flounder that move into the sGSL to feed during summer and early fall (DFO 2003b).

It is also worth noting species that have shown progressive decreases in size-composition, which may indicate a sign of stress on population status. One of the more noteworthy examples is winter flounder, which shows a progressive decreasing shift in length-distribution and a trend towards smaller maximum lengths captured since the mid-1980s. Longfin hake has shown similar patterns, although not as pronounced. Yellowtail flounder and rainbow smelt show a progressive decreasing shift in length-distribution, although maximum length captured is less affected.

4.2 Next steps – Towards a general status assessment for all of Atlantic Canada

Bottom-trawl surveys are conducted annually throughout Atlantic Canada, covering much of the area within Canada's jurisdiction. Jointly, data from these surveys provide a unique opportunity to determine the overall general status of many species that are captured. Furthermore, given the federal government's responsibility to regularly assess and report on the general status of all marine fish, it will be important to devise an approach by which the calculation of status indicators can be automated to the extent possible. We believe that an approach such as we have taken here may be amenable to such an automated integration.

Data from the bottom-trawl surveys led by the various Fisheries and Oceans Canada regions generally cannot be directly combined as different vessels and gears are used in many cases, and surveys are conducted at different times of the year. These are all factors known to affect the catchability and availability of fishes, something that cannot be overlooked in the absence of comparative fishing experiments among surveys. However, within surveys, standardised time series are often available, as is the case for the data presented in this report. These standardised series provide information on the relative change in the abundance, distribution and size-composition for the various species. Differences in catchability among surveys are therefore addressed by considering relative rather than absolute changes. The challenge then is in determining robust methods for combining these relative indicators of population status change into a single indicator for each species nationally. Although it may not be straight forward, this challenge is certainly not insurmountable and it is worth initiating a discussion on approaches to take. Analytical frameworks such as those developed for meta-analysis may be a good starting point.

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Table 1. Index of the sixty-three marine fish species for which general status in the sGSL was examined based on information from an annual bottom-trawl survey (1971-2002). Species are listed alphabetically by Order, Family, Genus and then Species. Cross-references to the appropriate rows in table 2 (summary of each species' life history, habitat and how well the survey represents its status) are provided. Figure numbers for each species are also indicated, each typically comprising two series of graphs: (a) time series of indicators of population abundance and distribution, and (b) yearly length-frequency distributions.

Order	Family	**Scientific name**	**Common name**	**Row #**	**Fig. #**
Aulopiformes	Paralepididae	Paralepididae spp.	Barracudinas	1	3
Clupeiformes	Clupeidae	*Alosa pseudoharengus*	Gaspereau	2	4
		Alosa sapidissima	America shad	3	5
		Clupea harengus	Atlantic herring	4	6
Gadiformes	Gadidae	*Boreogadus saida*	Arctic cod	5	7
		Gadus morhua	Atlantic cod	6	8
		Gadus ogac	Greenland cod	7	9
		Melanogrammus aeglefinus	Haddock	8	10
		Pollachius virens	Pollock	9	11
	Lotidae	*Enchelyopus cimbrius*	Fourbeard rockling	10	12
	Macrouridae	*Nezumia bairdii*	Marlin-spike grenadier	11	13
	Merlucciidae	*Merluccius bilinearis*	Silver hake	12	14
	Phycidae	*Phycis chesteri*	Longfin hake	13	15
		Urophycis tenuis	White hake	14	16
Gasterosteiformes	Gasterosteidae	*Gasterosteus aculeatus aculeatus*	Threespine stickleback	15	17
Lophiiformes	Lophiidae	*Lophius americanus*	Monkfish/goosefish	16	18
Myxiniformes	Myxinidae	*Myxine glutinosa*	Atlantic hagfish	17	19
Osmeriformes	Osmeridae	*Mallotus villosus*	Capelin	18	20
		Osmerus mordax mordax	Rainbow smelt	19	21
Perciformes	Ammodytidae	*Ammodytes dubius*	Northern sand lance	20	22
	Anarhichadidae	*Anarhichas denticulatus*	Northern wolffish	21	23
		Anarhichas lupus	Striped Atlantic wolffish	22	24
	Cryptacanthodidae	*Cryptacanthodes maculatus*	Wrymouth	23	25
	Labridae	*Tautogolabrus adspersus*	Cunner	24	26
	Scombridae	*Scomber scombrus*	Atlantic mackerel	25	27
	Stichaeidae	*Eumesogrammus praecisus*	Fourline snakeblenny	26	28
		Leptoclinus maculatus	Daubed shanny	27	29
		Lumpenus fabricii	Slender eelblenny	28	30
		Lumpenus lampretaeformis	Snakeblenny	29	31

Table 1 (continued)

Order	Family	**Scientific name**	**Common name**	**Row #**	**Fig. #**
Perciformes	Stichaeidae (cont.)	*Stichaeus punctatus punctatus*	Arctic shanny	30	32
		Ulvaria subbifurcata	Radiated shanny	31	33
Perciformes	Stromateidae	*Peprilus triacanthus*	Butterfish	32	34
	Zoarcidae	*Gymnelus viridis*	Fish doctor	33	35
		Lycodes spp.	Eelpouts (unseparated)	34	36
		Melanostigma atlanticum	Atlantic softpout	35	37
		Zoarces americanus	Common ocean pout	36	38
Pleuronectiformes	Pleuronectidae	*Glyptocephalus cynoglossus*	Witch flounder	37	39
		Hippoglossoides platessoides	American plaice	38	40
		Hippoglossus hippoglossus	Atlantic halibut	39	41
		Limanda ferruginea	Yellowtail flounder	40	42
		Pseudopleuronectes americanus	Winter flounder	41	43
		Reinhardtius hippoglossoides	Greenland halibut	42	44
	Scophthalmidae	*Scophthalmus aquosus*	Windowpane	43	45
Rajiformes	Rajidae	*Amblyraja radiata*	Thorny skate	44	46
		Leucoraja ocellata	Winter skate	45	47
		Malacoraja senta	Smooth skate	46	48
Scorpaeniformes	Agonidae	*Aspidophoroides monopterygius*	Alligatorfish	47	49
		Leptagonus dacagonus	Atlantic sea poacher	48	50
	Cottidae	*Artediellus uncinatus*	Arctic hookear sculpin	49	51
		Gymnocanthus tricuspis	Arctic staghorn sculpin	50	52
		Icelus spatula	Spatulate sculpin	51	53
		Myoxocephalus octodecemspinosus	Longhorn sculpin	52	54
		Myoxocephalus scorpioides	Arctic sculpin	53	55
		Myoxocephalus scorpius	Shorthorn sculpin	54	56
		Triglops murrayi	Moustache (mailed) sculpin	55	57
	Cyclopteridae	*Cyclopterus lumpus*	Lumpfish	56	58
		Eumicrotremus spinosus	Atlantic spiny lumpsucker	57	59
	Hemitripteridae	*Hemitripterus americanus*	Sea raven	58	60
	Liparidae	*Liparis* spp.	Seasnails (unseparated)	59	61
	Psychrolutidae	*Cottunculus microps*	Polar sculpin	60	62
	Sebastidae	*Sebastes* spp.	Redfish (unseparated)	61	63
Squaliformes	Dalatiidae	*Centroscyllium fabricii*	Black dogfish	62	64
	Squalidae	*Squalus acanthias*	Spiny dogfish	63	65

Table 2: General summary of the biology, demography, habitat, geographic range (in Canadian waters) and relation to man of marine fish species captured in the annual bottom-trawl survey of the sGSL (1971-2002). A general indication of reliability of the survey index and information on the current status of each species, as determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), are also provided. Details for each table column along with references are provided in the table footnote.

	Species name	Age at maturity (years)	Longevity (years)	Fecundity (R or K)	Spawning time	Habitat	% species range	Catchability /availability	Relation to man	COSEWIC assessment	References
1	Barracudinas (Paralepididae spp.)	Unkn.	Unkn.	Unkn.	Jan.-Sept.	Mesopelagic-bathypelagic, 125 – 450+ m	0-10 %	III			11d,e; 21d,e
2	Gaspereau (*Alosa pseudoharengus*)	3-5 (M<F)	F= 10, M= 8	R	Late Apr.-May (Margaree Riv.), early June-July (Miramichi Riv.)	Pelagic, anadromous, 0-110 m	0-10 %	II,V	Commercially harvested, used as bait in lobster and snow crab fisheries		11d; 21b,c;8b
3	American shad (*Alosa sapidissima*)	5	11	R	May-July	Pelagic, Anadromous, 0-220m	0-10 %	II,V	Commercially harvested, sport fishing		11d; 21b
4	Atlantic herring (*Clupea harengus*)	F and M= 3-5	11	R	Apr.-Nov.	Pelagic, coastal 0-200m	0-10 %	I, II, IV	Commercially harvested, bait fishery		1b; 9b 11d; 21b,c
5	Arctic cod (*Boreogadus saida*)	F= 3-5, M= 2-3	6-7	R	Dec.-March	Demersal, 0-300 m	0-10 %	VI	May be commercially harvested		7c; 11d; 21c.
	Atlantic cod (Gadus morhua)	F = 6-8, M= 5-7	20	R	May-Sept.	Benthopelagic, 0-450+ m	0-10 %	I	Commercially harvested, sport fishing	Designated special concern (May 2003)	11d; 14b; 21b,c;
7	Greenland cod (*Gadus ogac*)	3-4	11	R	Feb.-March	Demersal, 0-200 m	30-50 %	I	Minor commercial harvesting	Lower priority cand.	7c; 11d; 21c
8	Haddock (*Melanogrammus aeglefinus*)	F and M= 3-5	15	R	Jan.-July	Demersal, 25-300+ m	0-10 %	VIII	Commercially harvested	Highest priority cand.	11d; 21b,c
9	Pollock (*Pollachius virens*)	F=5-7, M=4-6	15	R	Nov.-March	Benthopelagic, 35-300+ m	0-10 %	III, VIII	Commercially harvested, sport fishing	Highest priority cand.	3b; 7c; 11d; 16c; 21b

Table 2 (continued)

	Species name	Age at maturity (years)	Longevity (years)	Fecundity (R or K)	Spawning time	Habitat	% species range	Catchability /availability	Relation to man	COSEWIC assessment	References
10	Fourbeard rockling (*Enchelyopus cimbrius*)	3	9	R	Late May-Oct.	Demersal, 20-550 m	0-10 %	II-III			7c; 11d; 21c
11	Marlin-spike grenadier (*Nezumia bairdii*)	3	10	R	Summer-autumn	Benthopelagic, 200-450+ m	0-10 %	III	Caught as by-catch	Lower priority cand.	7c; 11d; 21c
12	Silver hake (*Merluccius bilinearis*)	F and M= 2-4	12	R	June-Sept.	Demersal, 30-450+ m	0-10 %	VIII	Commercially harvested	Highest priority cand.	3b; 11d; 21c
13	*Longfin hake* (Phycis chesteri)	unkn.	unkn.	R	Dec.-Jan.	Demersal, 250-450+ m	0-10 %	III	Minor commercial harvesting, caught as by-catch		7c; 11d; 21c
14	White hake (*Urophycis tenuis*)	F= 3-5, M= 2-4	15 +	R	June-Sept.	Demersal, 30-400+ m	0- 10 %	II-III	Commercially harvested, caught as by-catch	Highest priority cand.	7c; 11d; 16c; 21b,c
15	Threespine stickleback (*Gasterosteus aculeatus aculeatus*)	1	3-3.5	R/K	June or July	Benthopelagic, anadromous, 0-100 m	10-20 %	V	Used as laboratory animal for research		11d; 20c; 21c
16	Monkfish, goosefish (*Lophius americanus*)	3-4	11	R	June-Sept.	Demersal, 0-450+ m	0-10 %	III	Commercially harvested (not directed), caught as by-catch, used as laboratory animal for research	Intermed. priority cand.	2d, 11d; 21c
17	Atlantic hagfish (*Myxine glutinosa*)	unkn.	unkn.	K	Year round (can be hermaphroditic)	Demersal, 150-450+ m	0-10 %	III	Used as laboratory animal for research	Intermed. priority cand.	11d; 21c
18	Capelin (*Mallotus villosus*)	F and M= 3-4	5-7	R	June-July	Pelagic, 0-400+ m	0-10 %	IV	Commercially harvested		11d; 21b,c
19	Rainbow smelt (*Osmerus mordax mordax*)	F and M= 2-3	6	R	Late Apr.-early June (Miramichi Riv.)	Pelagic, anadromous, 0-150 m	0-10 %	II, V	Commercially harvested, sport fishing		11d; 20c; 21b,c
20	Northern sand lance (*Ammodytes dubius*)	2	9	R	Late Nov.-late Feb.	Demersal, 20-100 m	0-10 %	II	caught as by-catch	Highest priority cand.	11d; 21c; 22b
21	Northern wolffish (*Anarhichas denticulatus*)	7+	unkn.	R/K	Late autumn-early winter	Benthopelagic, 100-300 m^2	0-10 %	VIII	Caught as by-catch	Designated threatened (May 2001)	11d; 21c

Table 2 (continued)

	Species name	Age at maturity (years)	Longevity (years)	Fecundity (R or K)	Spawning time	Habitat	% species range	Catchability /availability	Relation to man	COSEWIC assessment	References
22	Striped Atlantic wolffish (*Anarhichas lupus*)	8-10	20	R/K	Aug.-Sept.	Demersal, 50-350 m	0-10 %	I	Caught as by-catch	Designated special concern (Nov. 2000)	11d; 21c
23	Wrymouth (*Cryptacanthodes maculatus*)	unkn.	unkn.	R	Winter or spring	Demersal, 25-120 m	50-60 %	I	Used as laboratory animal for research	Lower priority cand.	11d; 21b,c
24	Cunner (*Tautogolabrus adspersus*)	2-3	10	R	June-Aug.	Reef-associated, 15-100 m	70-80 %	II	Minor commercial harvesting, sport fishing		11d; 21b,c
25	Atlantic mackerel (*Scomber scombrus*)	F and M= 2-4	17	R	Mid-June to mid-July	Pelagic, 20-200 m	0-10 %	IV	Commercially harvested, sport fishing		11d; 21b,c
26	Fourline snakeblenny (*Eumesogrammus praecisus*)	unkn.	unkn.	unkn.	unkn.	Benthopelagic, 10-400 m	70-80 %	I, VII			11d; 21c
27	Daubed shanny (*Leptoclinus maculatus*)	unkn.	unkn.	R	Winter	Demersal, 0-110 m	20-30 %	I		Lower priority cand.	11d; 21c
28	Slender eelblenny (*Lumpenus fabricii*)	unkn.	unkn.	R	July	Benthopelagic, 0-200 m	0-10 %	I			11d; 21c
29	Snakeblenny (*Lumpenus lampretaeformis*)	3	unkn.	R	Autumn or winter	Demersal, 30-200 m	20-30 %	I	Bait in European fisheries		11d; 21c; 24d
30	Arctic shanny (*Stichaeus punctatus punctatus*	F= 6, M= 5	unkn.	R	Feb.-March	Demersal, 0-55 m	0-10 %	VI			10c; 11d; 21c
31	Radiated shanny (*Ulvaria subbifurcata*)	F= 5, M= 4	F= 8, M= 10	R	Early spring-summer	Benthopelagic, 45-140 m	30-40 %	II		Highest priority cand.	11d; 13c; 21c
32	Butterfish (*Peprilus triacanthus*)	2	4-5	R	June-Aug.	Benthopelagic, 30-270 m	10-20 %	II			11d; 21c
33	Fish doctor (*Gymnelus viridis*)	unkn.	unkn.	K	Late summer-early autumn	Demersal, 0-250 m	0-10 %	I			11d; 21c

Table 2 (continued)

	Species name	**Age at maturity (years)**	**Longevity (years)**	**Fecundity (R or K)**	**Spawning time**	**Habitat**	**% species range**	**Catchability /availability**	**Relation to man**	**COSEWIC assessment**	**References**
34	Unseparated eelpouts (*Lycodes* spp.)	unkn.	unkn.	K	Summer or early autumn	Demersal-bathydemersal, 10-450+ m	10-20 %	I	Caught as by-catch	Highest priority cand. (*L. reticulatus and L. vahli*)	11d; 21c
35	Atlantic softpout (*Melanostigma atlanticum*)	unkn.	unkn.	K	July-Sept.	Bathypelagic, 120-360 m	0-10 %	III			11d; 21b,c
36	Common ocean pout (*Zoarces americanus*)	F= 6-7, M= 3-4	16	K	Late Aug.	Demersal, 25-185 m	0-20 %	I	Caught as by-catch, used as laboratory animal for research		11d; 16c; 21c; 26c
37	Witch flounder (*Glyptocephalus cynoglossus*)	F= 8-10, M=4-6	>30	R	March-Sept.	Demersal, 15-300+ m	0-10 %	III	Commercially harvested	Lower priority cand.	11d; 21b,c
38	American plaice (*Hippoglossoides platessoides*)	F= 7-15, M =5-7	25	R	Early Apr.-June	Demersal, 35-300+ m	10-20 %	I	Commercially harvested	Highest priority cand.	11d; 19b,c; 21c
39	Atlantic halibut (*Hippoglossus hippoglossus*)	F= 8-11, M= 6-10	50	R	Late winter-early spring	Demersal, 20-400+ m	0-10 %	I	Commercially harvested, caught as by-catch	Highest priority cand.	11d; 21c; 25b,c
40	Yellowtail flounder (*Limanda ferruginea*)	F= 5, M= 4	12	R	May-July	Demersal, 25-300+ m	0-20 %	II	Commercially harvested, caught as by-catch	Intermed. priority cand.	11d; 17c; 21c
41	Winter flounder (*Pseudopleuronectes americanus*)	F= 4, M= 3	15	R	Apr.-early June	Demersal, 0-150 m	0-20 %	II	Commercially harvested, caught as by-catch, sport fishing		11d; 18b,c; 21c; 26c
42	Greenland halibut (*Reinhardtius hippoglossoides*)	F= 9, M= 7	30	R	Winter	Benthopelagic, 90-450+ m	0-10 %	III	Commercially harvested, caught as by-catch	Lower priority cand.	5b,c; 11d; 21c
43	Windowpane (*Scophthalmus aquosus*)	3-4	unkn.	R	Late spring-early summer	Demersal, 75-200 m	30-50 %	II	Caught as by-catch, used as laboratory animal for research	Lower priority cand.	11d; 21c

Table 2 (continued)

	Species name	Age at maturity (years)	Longevity (years)	Fecundity (R or K)	Spawning time	Habitat	% species range	Catchability /availability	Relation to man	COSEWIC assessment	References
44	Thorny skate (*Amblyraja radiata*)	unkn.	unkn.	K	Year-round	Demersal, 15-450+ m	0-10 %	I	Caught as by-catch	Intermed. priority cand.	11d; 21c
45	Winter skate (*Leucoraja ocellata*)	unkn.	unkn.	K	Summer-autumn	Demersal, 20-300+ m	10-30 %	II	Caught as by-catch, used as laboratory animal for research		11d; 21b,c
46	Smooth skate (*Malacoraja senta*)	unkn.	unkn.	K	unkn.	Demersal, 30-450+ m	0-10 %	III	Caught as by-catch	Highest priority cand.	11d; 21c
47	Alligatorfish (*Aspidophoroides monopterygius*)	unkn.	unkn.	R	unkn.	Demersal 15-300+ m	10-40 %	I			11d; 21c
48	Atlantic sea poacher (*Leptagonus decagonus*)	unkn.	unkn.	R	Late spring	Demersal, 25-300+ m	0-10 %	I			11d; 21c
49	Arctic hookear sculpin (*Artediellus uncinatus*)	unkn.	unkn.	K	Summer	Demersal, 10-185 m	20-30 %	I			11d; 21c
50	Arctic staghorn sculpin (*Gymnocanthus tricuspis*)	unkn.	unkn.	K	Autumn	Demersal, 20-175 m	0-10 %	VI		Highest priority cand.	11d; 21c
51	Spatulate sculpin (*Icelus spatula*)	unkn.	unkn.	R	Aug.-Sept.	Demersal, 0-125 m	0-10 %	I, VI			11d; 21c
52	Longhorn sculpin (*Myoxocephalus octodecemspinosus*)	3	6	R	Winter	Demersal, 0-125 m	10-20 %	II		Intermed. priority cand.	11d; 21c; 26c
53	Arctic sculpin (*Myoxocephalus scorpioides*)	unkn.	unkn.	K	unkn.	Demersal, 0-75 m	0-10 %	VI		Highest priority cand.	11d; 21c
54	Shorthorn sculpin (*Myoxocephalus scorpius*)	F= 6-8, M= 4-6	15	K	Late Nov.-early Dec.	Demersal, 25-145 m	10-20 %	II	Used as bait in lobster fishery, used as laboratory animal for research	Lower priority cand.	11d; 21c
55	Moustache (mailed) sculpin (*Triglops murrayi*)	unkn.	unkn.	R	Summer-autumn	Demersal, 15-300+ m	10-30 %	I		Intermed. priority cand.	11d; 21c

Table 2 (continued)

	Species name	**Age at maturity (years)**	**Longevity (years)**	**Fecundity (R or K)**	**Spawning time**	**Habitat**	**% species range**	**Catchability /availability**	**Relation to man**	**COSEWIC assessment**	**References**
56	Lumpfish (*Cyclopterus lumpus*)	3	12	R	Early spring-July	Benthopelagic, 0-300+ m	0-10 %	I	Commercially harvested (roe fishery), may be used as bait in longline fishery	Lower priority cand.	11d; 21c; 26c
57	Atlantic spiny lumpsucker (*Eumicrotremus spinosus*)	unkn.	unkn.	unkn.	Aug.-Sept.	Demersal, 5-85 m	10-20 %	I, VII			11d; 21c
58	Sea raven (*Hemitripterus americanus*)	unkn.	unkn.	K/R	Late autumn-early winter	Demersal 0-100 m	0-10 %	II	Used as bait in lobster fishery, used as laboratory animal for research	Highest priority cand.	11d; 21c
59	Unseparated seasnails (*Liparis* spp.)	unkn.	unkn.	unkn.	June-Aug.	Demersal-bathydemersal, 50-200 m	10-30 %	I			11d; 21c
60	Polar sculpin (*Cottunculus microps*)	unkn.	unkn.	R	unkn.	Bathydemersal 55-450+ m	0-10 %	VI			11d; 21c
61	Unseparated redfish (*Sebastes* spp.)	10-12	80	K/R	Ovoviviparous, March-July	Demersal-bathydemersal, 140-450+ m	0-10 %	III	Commercially harvested	Highest priority cand. (*S. marinus*)/ Intermed. priority cand. (*S. mentella*)	11d; 15b,c; 21c
62	Black dogfish (*Centroscyllium fabricii*)	unkn.	unkn.	K	Ovoviviparous unkn.	Bathydemersal 275-450+ m	0-10 %	III, V	Caught as by-catch	Lower priority cand.	11d; 21c
63	Spiny dogfish (*Squalus acanthias*)	F= 12 M = 6	F=40, M=30	K	Ovoviviparous Winter	Benthopelagic, 0-450+	10-20 %	I, V	Commercially harvested, used as laboratory animal for research		11d; 21c; 26c

Table 2 (continued): **Footnote**

Age at maturity and longevity:
Information provided separately for female (F) and males (M), when available. Longevity is an approximate estimate for the species (not necessarily the maximum recorded).

Fecundity and spawning time:
Information on time of spawning and general spawning strategy adopted by the species; few large eggs or young (K-species) or relatively many small eggs or young (R-species). Cases of ovoviviparity are also noted.

Habitat:
General summary of whether the species occurs in open waters (pelagic), on or near bottom (demersal), and/or inshore (coastal), along with the species' approximate depth range. Diadromous species are also noted.

Percent species range:
Approximate percentage of the species range (Northwest Atlantic, Canadian waters only) which occurs in the sGSL. The percentage was evaluated based on the East Coast of North America Strategic Assessment Project (ECNASAP) Groundfish Atlas[6] or when not available, the Biological Observations, Specimens and Collections (BiOSC) Gateway from the Integrated Taxonomic Information System (ITIS)[4].

Catchability / availability:
Indication of the reliability of the survey in providing information on the relative abundance and distribution of the species captured in the sGSL in September. The broad categories outlined below do not necessarily indicate that the survey does not provide a valid index of abundance and distribution, but rather are meant to aid the reader in interpreting the results:

I-Reasonable coverage and catchability .
II-Shallow water species; survey does not cover all of the area occupied
III-Deep-water species (>100 m); survey may not cover all of the area occupied.
IV-Pelagic species infrequently captured, or with low and variable catchability to the survey gear.
V-Seasonally migrating or diadromous species whose geographic distribution likely extends beyond the survey area in September.
VI-Arctic or sub-arctic species whose distribution typically doesn't extend into the survey area.
VII-Species much more catchable at night which may have been less well sampled prior to 1985 (daytime fishing only).
VIII-The SGSL is at the limit of the geographic distribution for this species.

Relation to man:
Summary of the species' uses by mankind.

Table 2 (continued): **Footnote con't**

COSEWIC assessment:
Indication whether the species has been or is scheduled to be reviewed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The following categories have been used:

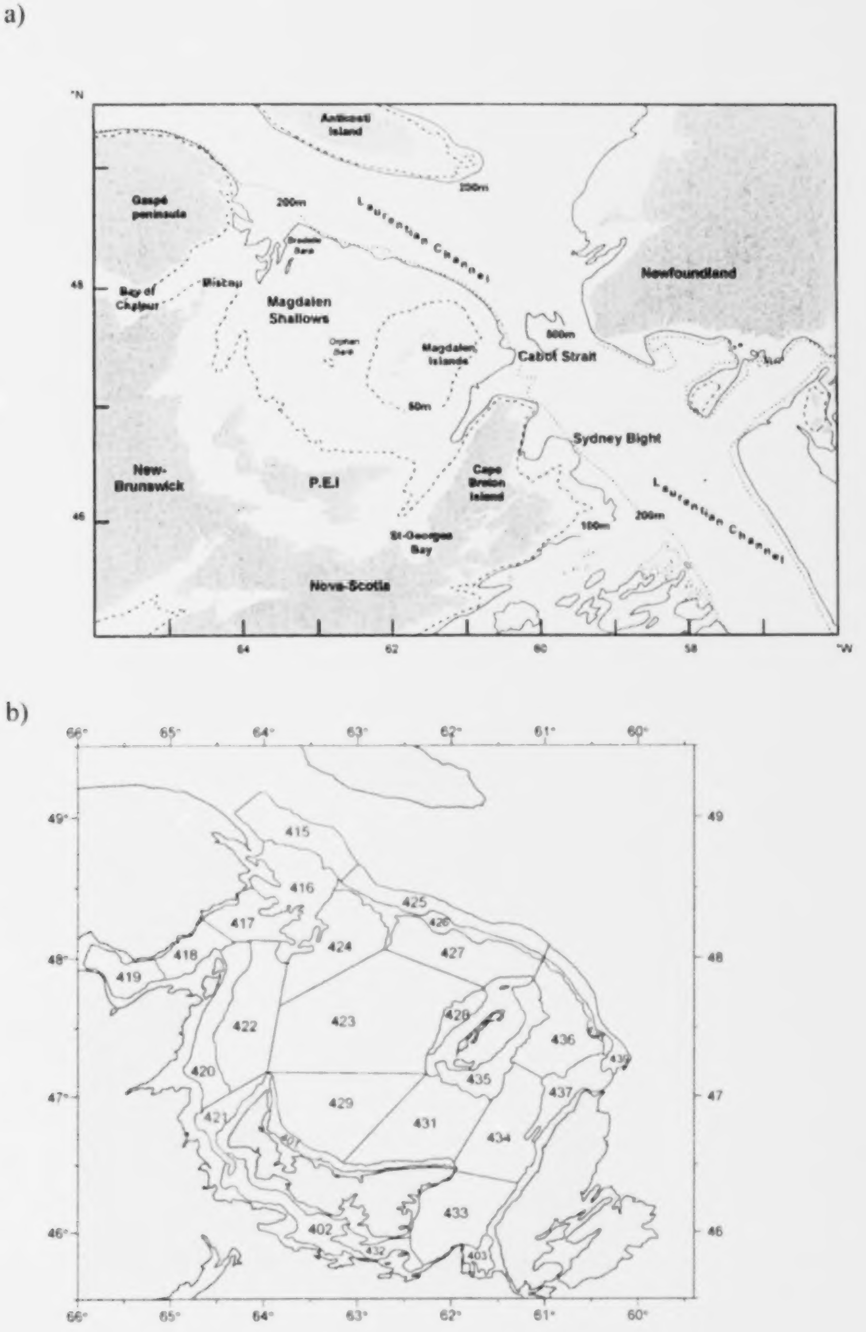
Endangered - Species facing imminent extirpation or extinction (note there are currently no species of marine fish in the sGSL with this designation).
Threatened - Species likely to become endangered if limiting factors are not reversed.
Special concern - Species particularly sensitive to human activities or natural events.
Highest priority candidate for review- Species that are suspected to be extirpated from Canada.
Intermediate priority candidate for review- Species that are of intermediate priority for COSEWIC assessment.
Lower priority candidate for review- Species that are of lower priority for COSEWIC assessment.

References (format):
To the extent possible, the information provided on maturity, longevity, spawning time and habitat is specific to the sGSL, although in some cases, information from broader geographic areas is presented. These cases are noted in the reference column as follows:

a) specifically for the populations of the sGSL.
b) specifically for the populations of the Maritimes (New-Brunswick, Nova-Scotia, and Prince-Edward Island).
c) commonly for the populations of the Northwest Atlantic (Canadian and American east coasts, including Newfoundland).
d) commonly for the populations of the northern Atlantic (north of the equator, including Greenland, occidental Europe, and northern Africa).
e) commonly for the family, in the northern Atlantic.

References cited:

1) Ahrens, 1990
2) Armstrong et al., 1992
3) Beacham, 1983
4) BioSC, 2003
5) Bowering, 1984
6) Brown et al., 1996
7) Cohen et al., 1990
8) DFO, 2001
9) DFO, 2002a
10) Farwell et al., 1976
11) Froese and Pauly, 2003
12) Haedrich and Merrett, 1988
13) Le Drew and Green, 1975
14) Lear, 1989
15) McKone and LeGrow, 1984
16) O'Brien et al., 1993
17) Pitt, 1983
18) Pitt, 1984a
19) Pitt, 1984b
20) Scott and Crossman, 1973
21) Scott and Scott, 1988
22) Scott, J.S., 1968
23) Van Guelpen, 1989
24) Wheeler, 1992
25) Zwanenburg, 1984
26) Collette and Klein-MacPhee, 2002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Anticosti Island
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Bay of Chaleur
Miscou
Magdalen Shallows
Orphan Bank
Magdalen Islands
500m
Cabot Strait
50m
Sydney Bight
New-Brunswick
P.E.I
Cape Breton Island
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St-Georges Bay
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Figure 1. (a) Geographic and bathymetric map for the southern Gulf of St. Laurence and surrounding areas, and (b) stratum boundaries for the September bottom-trawl survey.

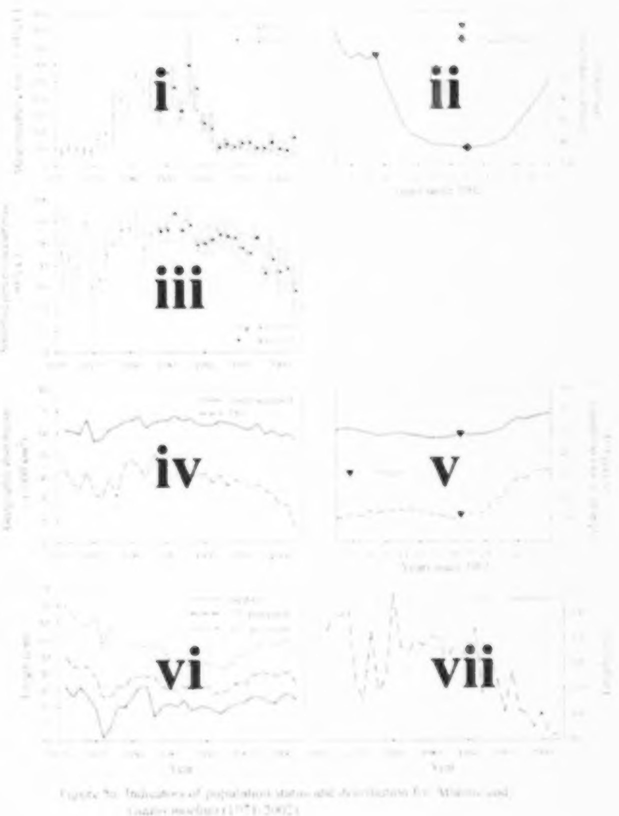

Figure 2: Example of graph 'a' showing time trends in the various indicators of population status and distribution for each species. See text for explanation (section 3.1).

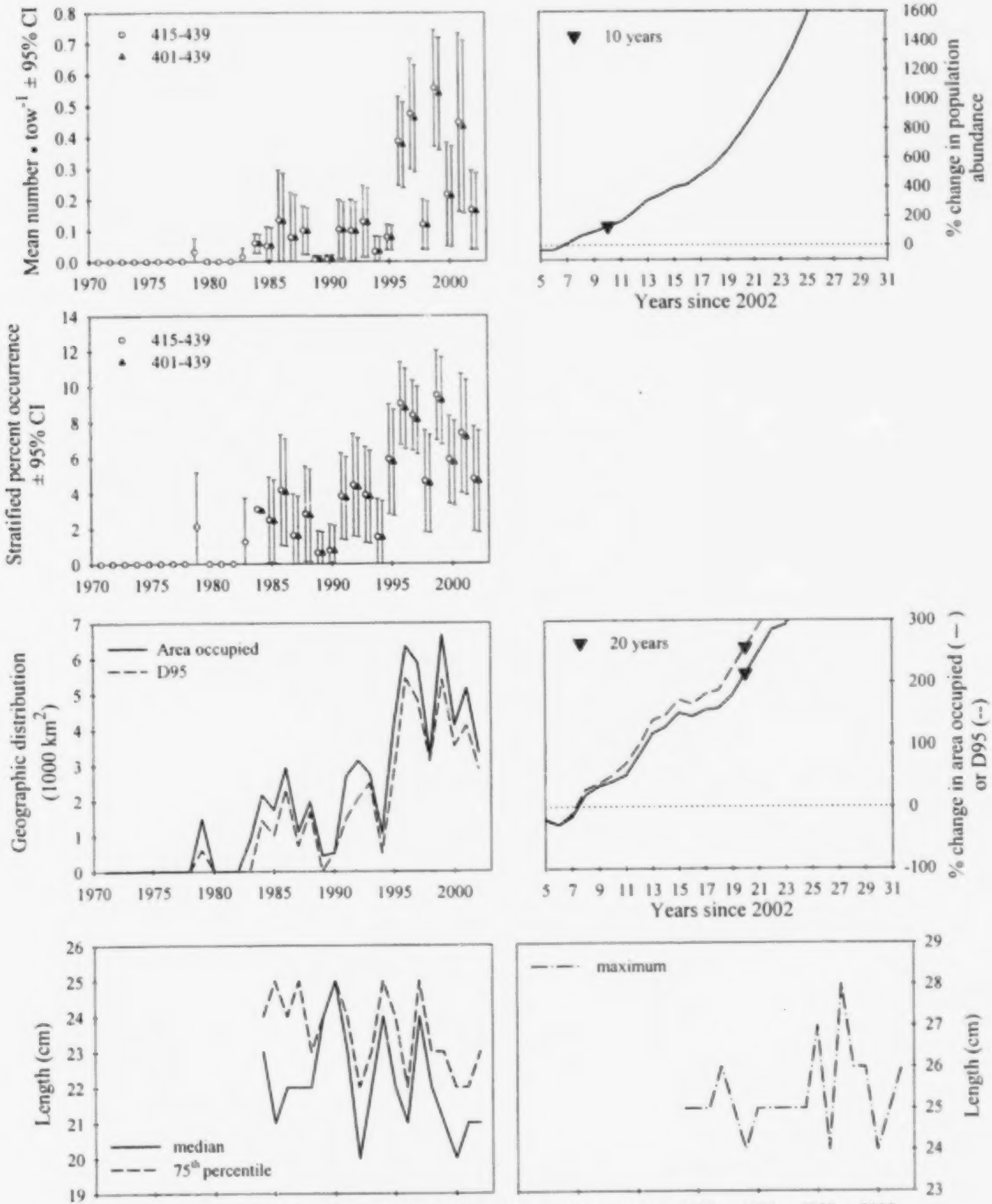

Figure 3a: Indicators of population status and distribution for barracudinas, Paralepididae spp. (1971-2002).

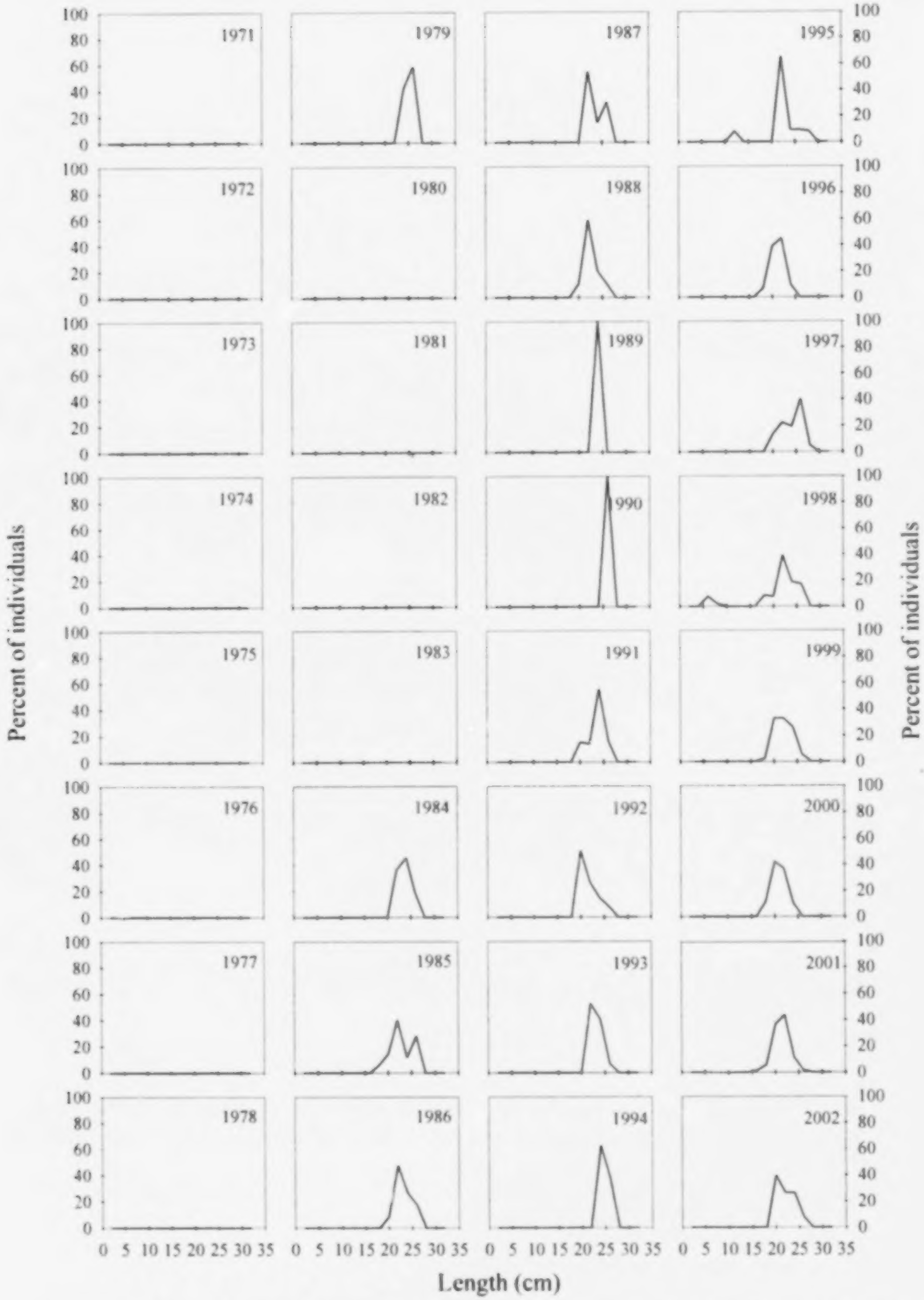

Figure 3b: Yearly length frequency distributions for barracudinas (Paralepididae spp.).

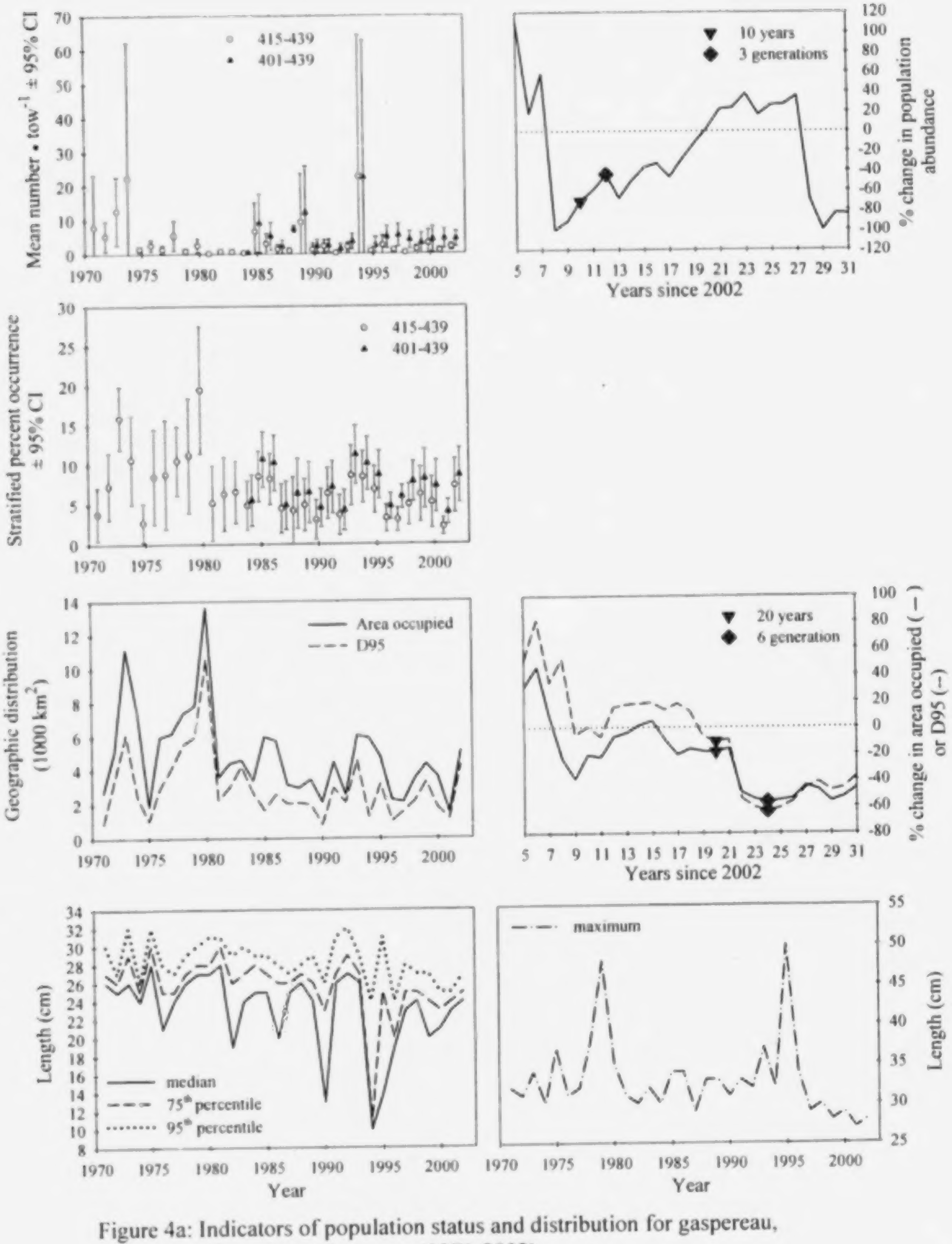

Figure 4a: Indicators of population status and distribution for gaspereau, *Alosa pseudoharengus* (1971-2002).

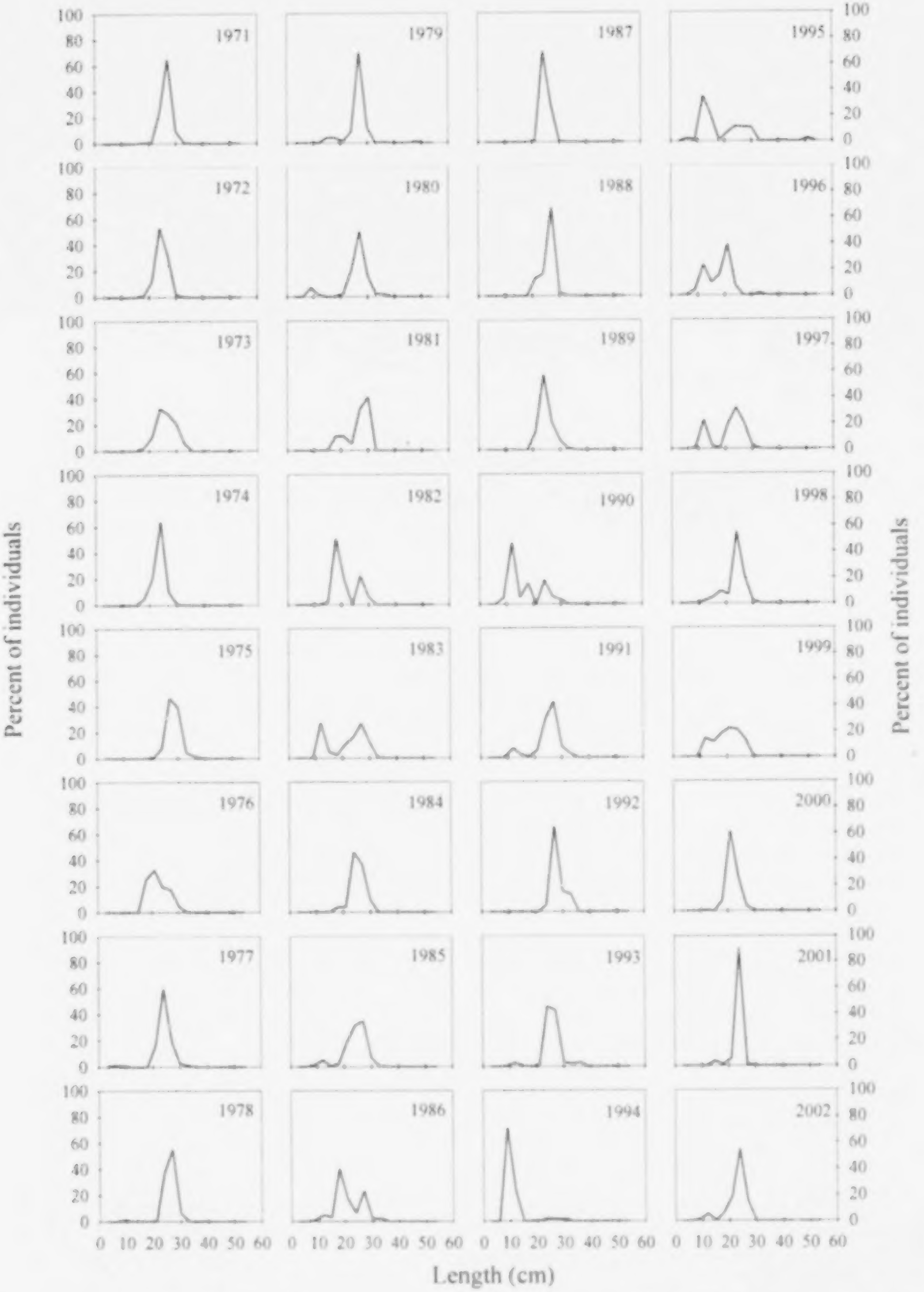

Figure 4b: Yearly length frequency distributions for gaspereau (*Alosa pseudoharengus*).

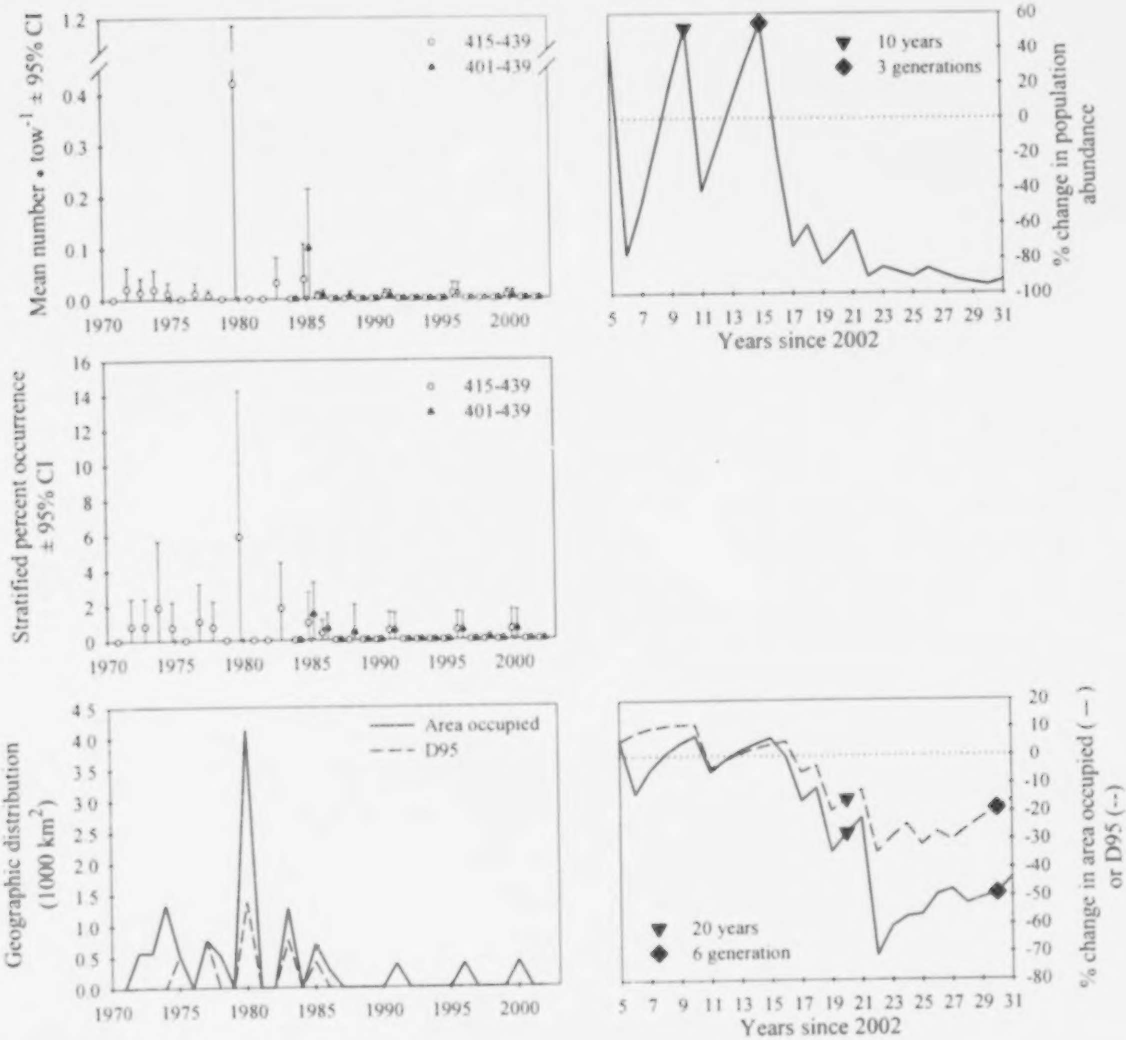

Figure 5a: Indicators of population status and distribution for American shad, *Alosa sapidissima* (1971-2002).

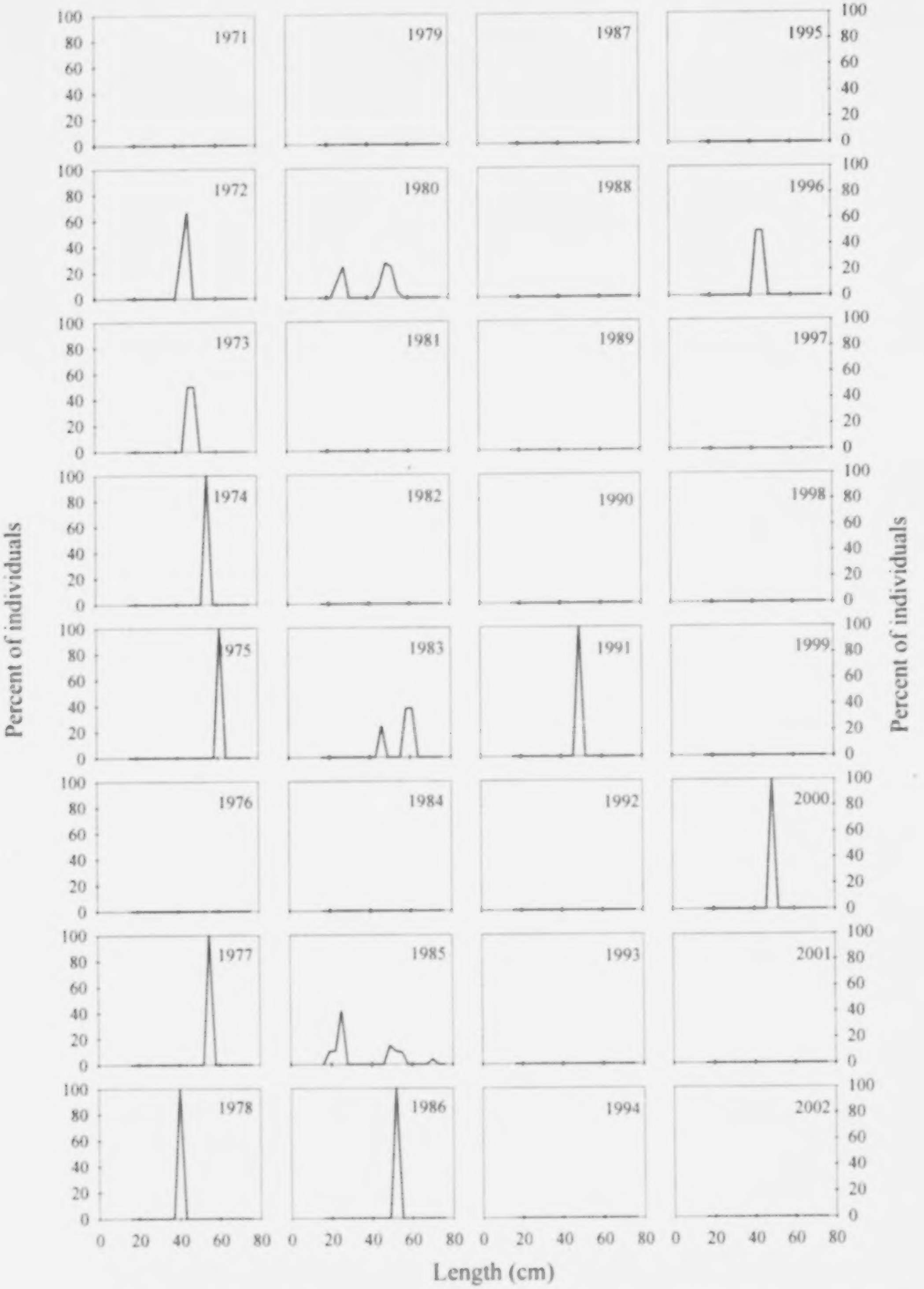

Figure 5b: Yearly length frequency distributions for American shad (*Alosa sapidissima*).

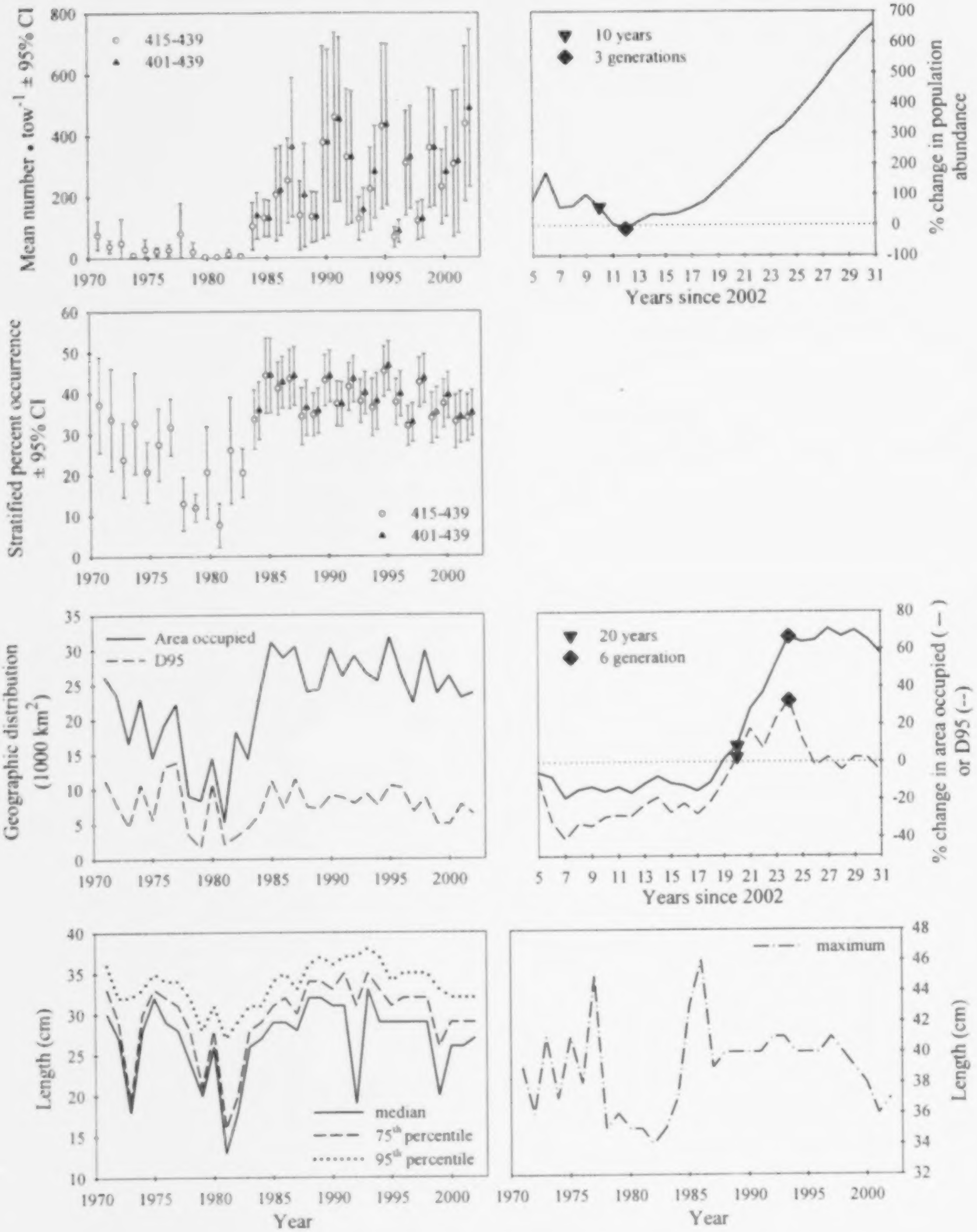

Figure 6a: Indicators of population status and distribution for Atlantic herring, *Clupea harengus* (1971-2002).

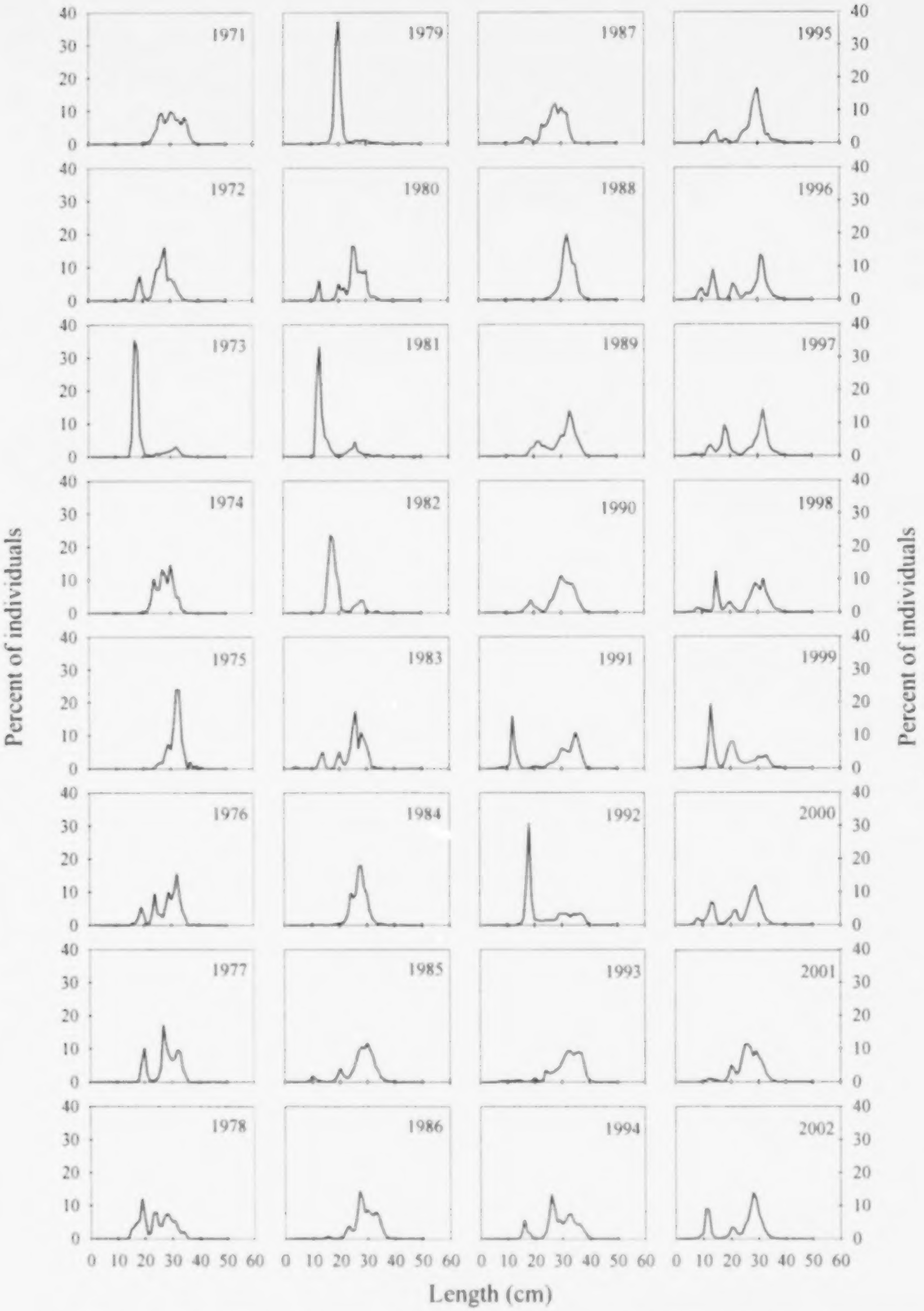

Figure 6b: Yearly length frequency distributions for Atlantic herring (*Clupea harengus*).

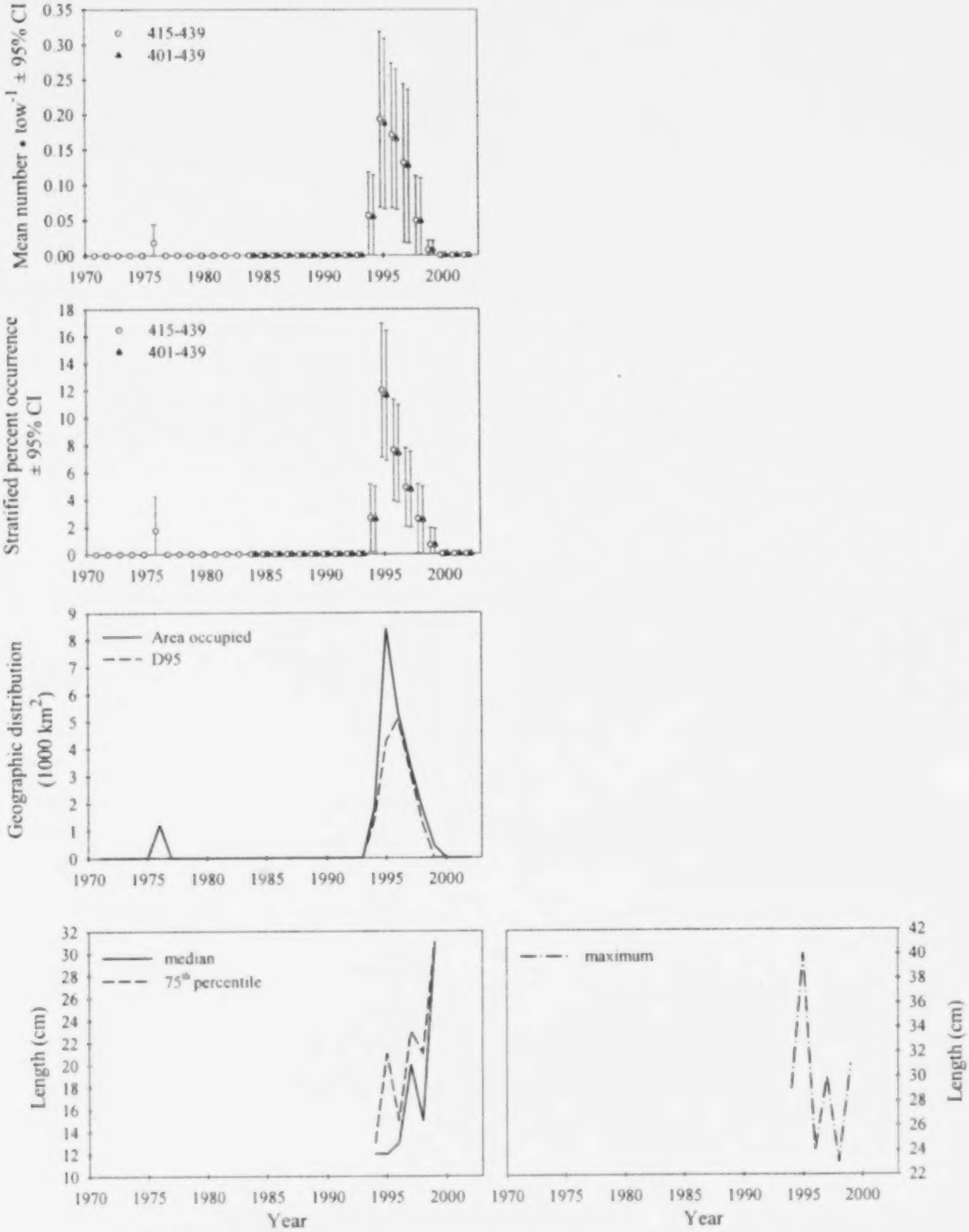

Figure 7a: Indicators of population status and distribution for Arctic cod, *Boreogadus saida* (1971-2002).

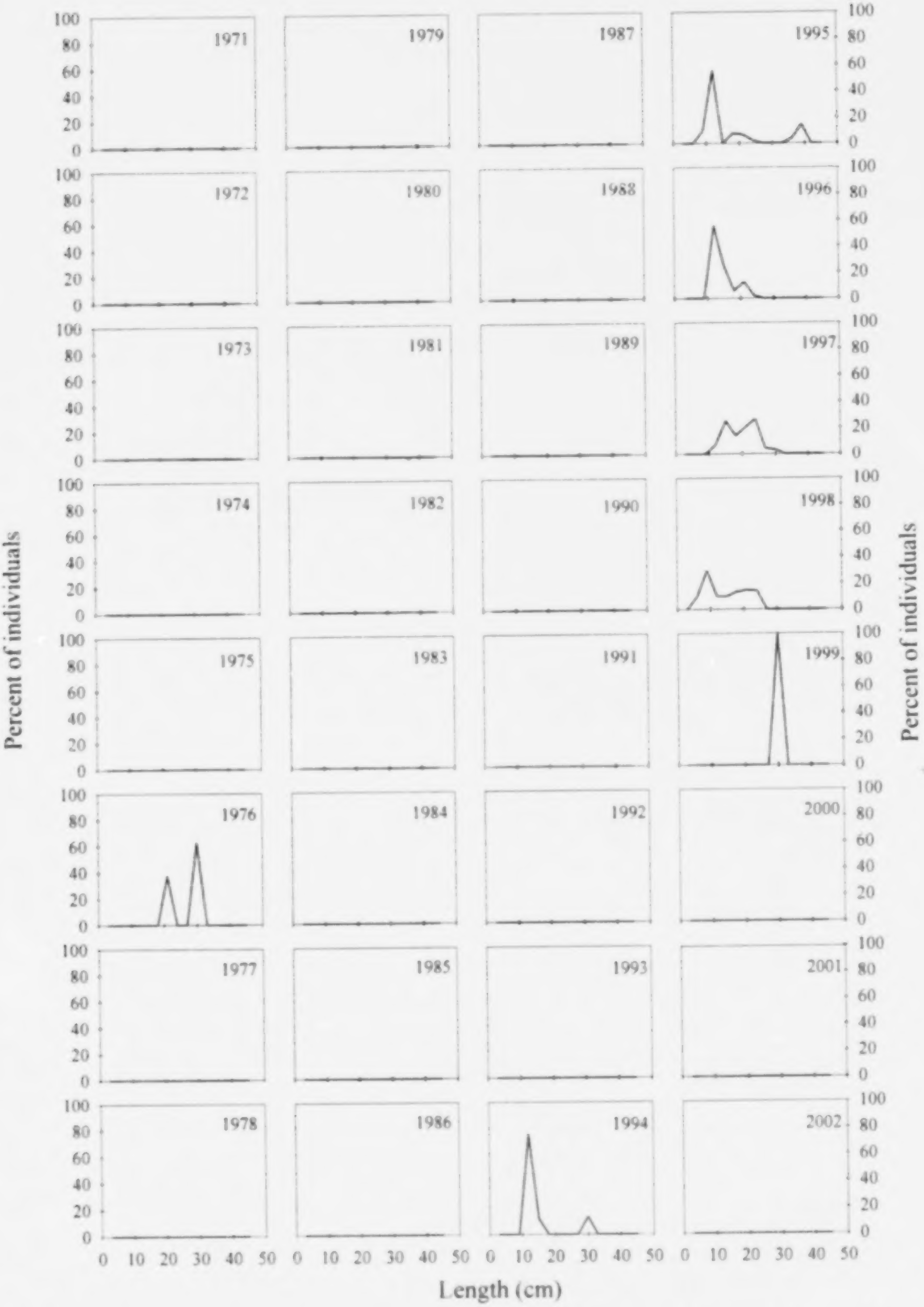

Figure 7b: Yearly length frequency distributions for Arctic cod (*Boreogadus saida*).

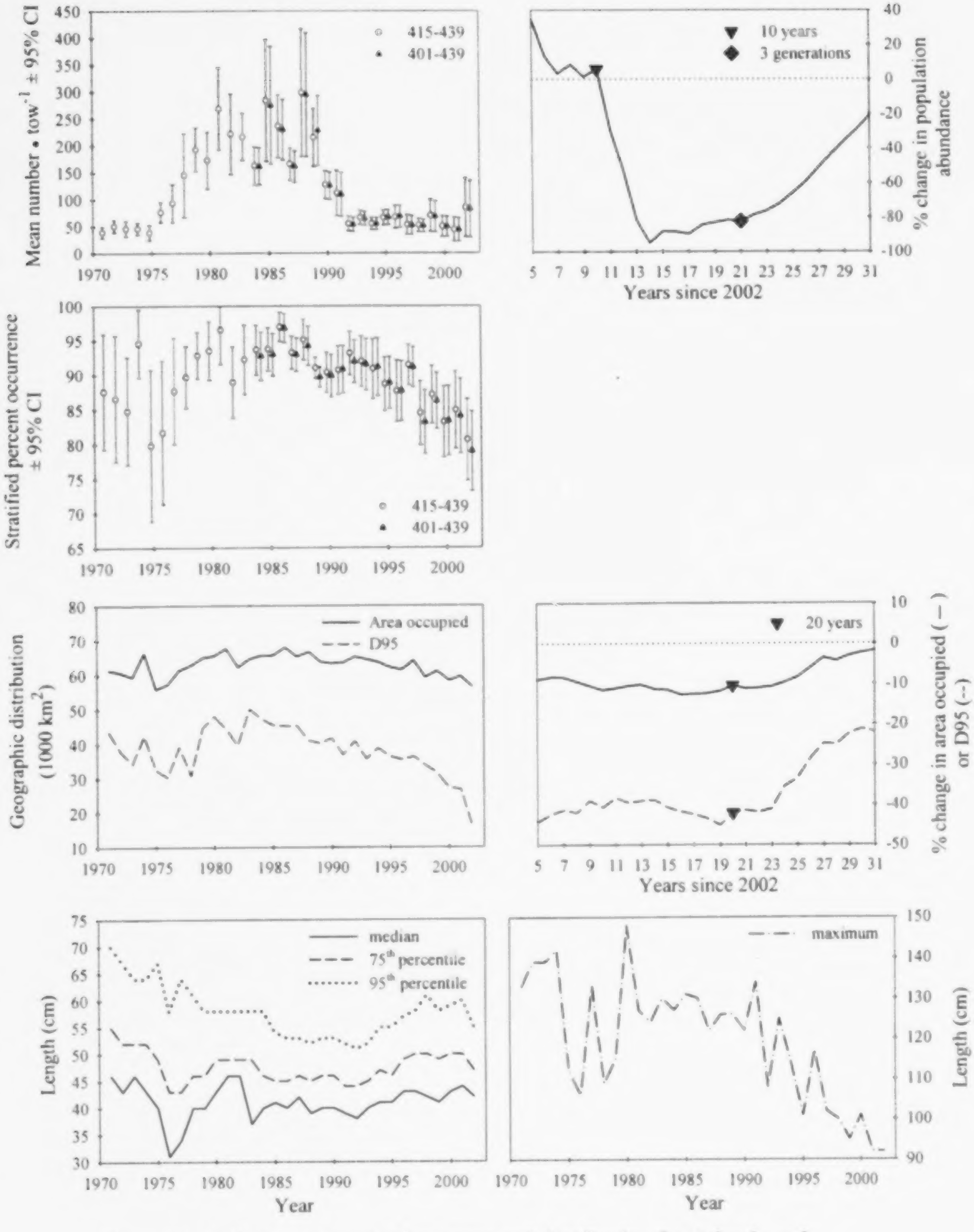

Figure 8a: Indicators of population status and distribution for Atlantic cod, *Gadus morhua* (1971-2002).

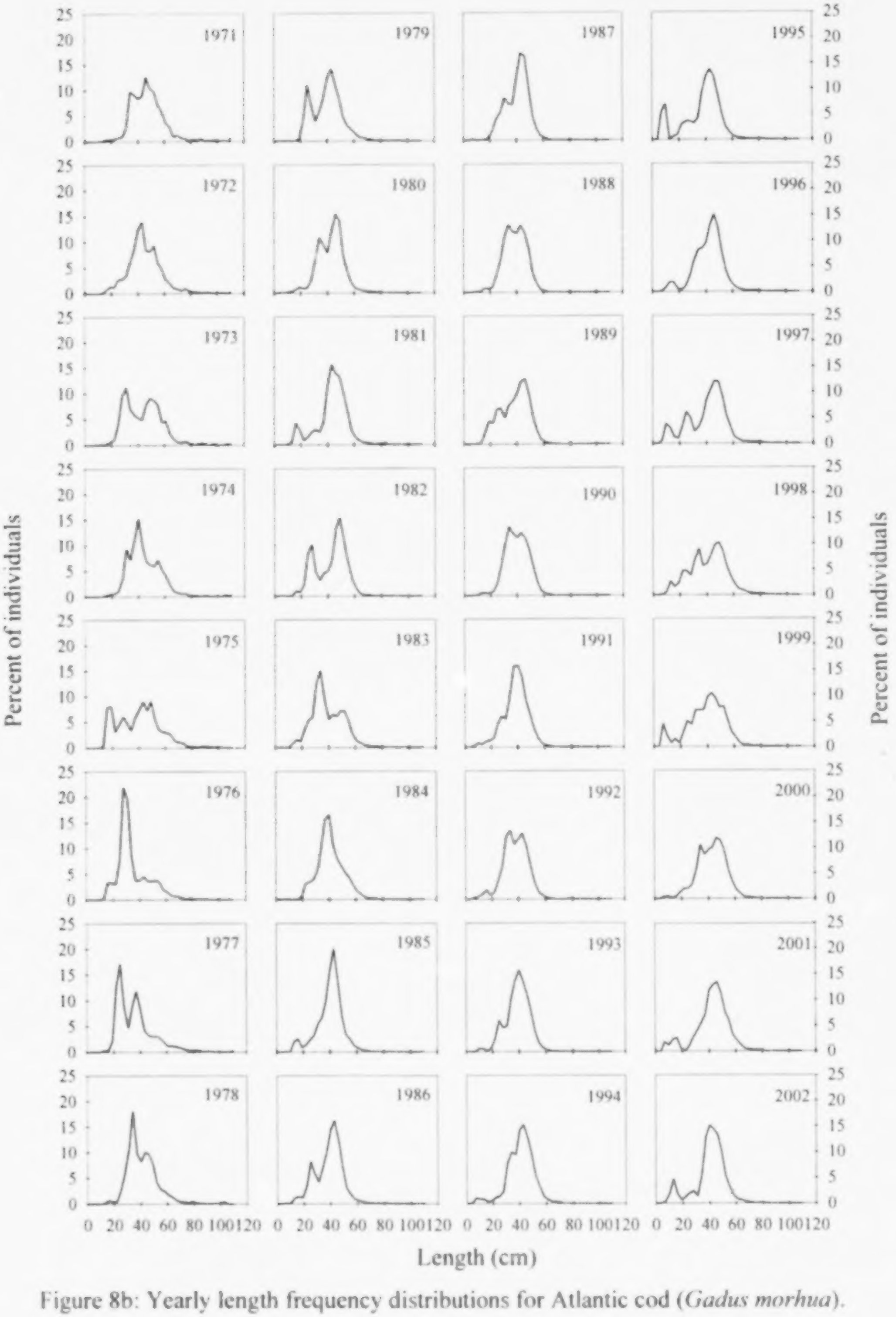

Figure 8b: Yearly length frequency distributions for Atlantic cod (*Gadus morhua*).

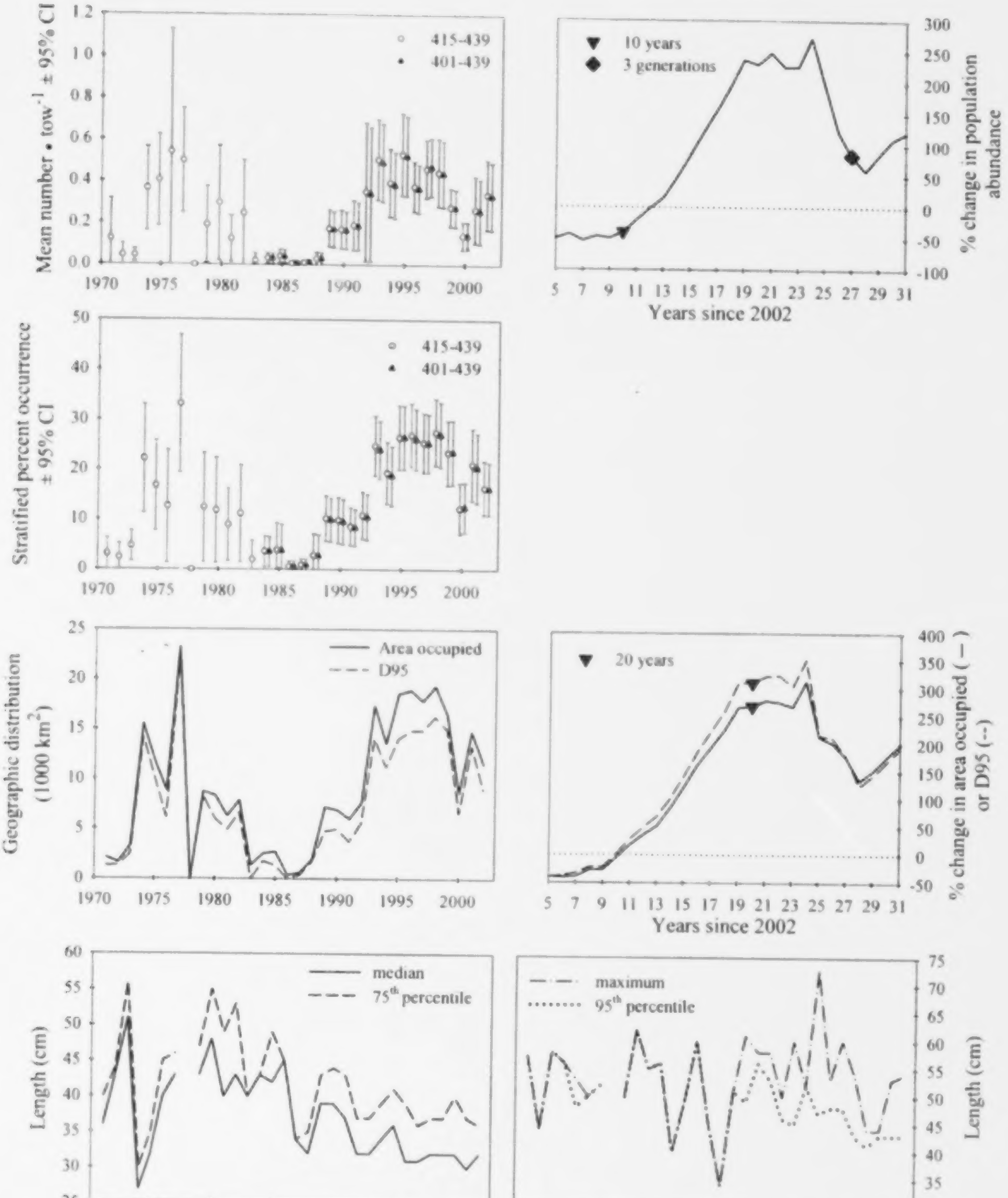

Figure 9a: Indicators of population status and distribution for Greenland cod, *Gadus ogac* (1971-2002).

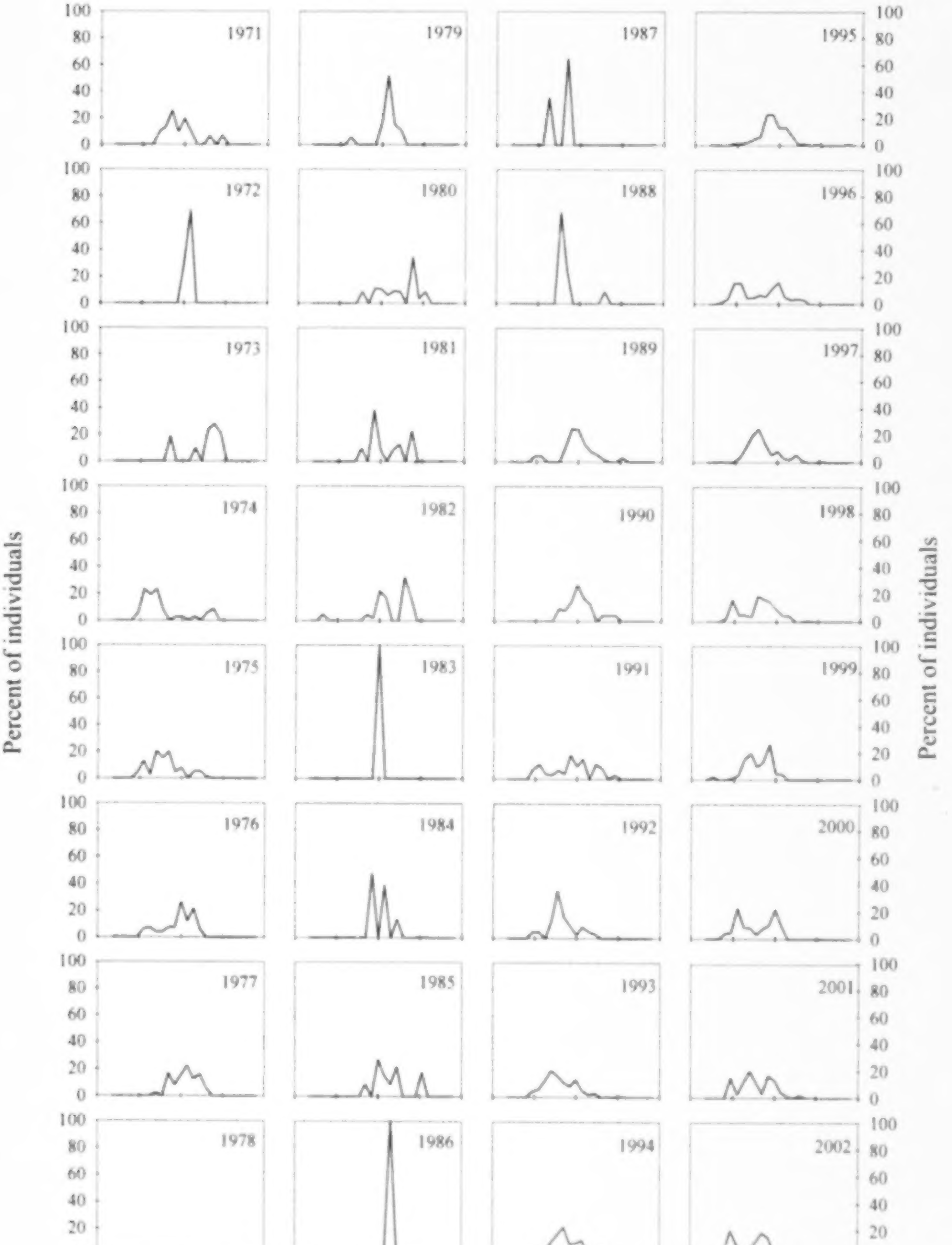

Figure 9b: Yearly length frequency distributions for Greenland cod (*Gadus ogac*).

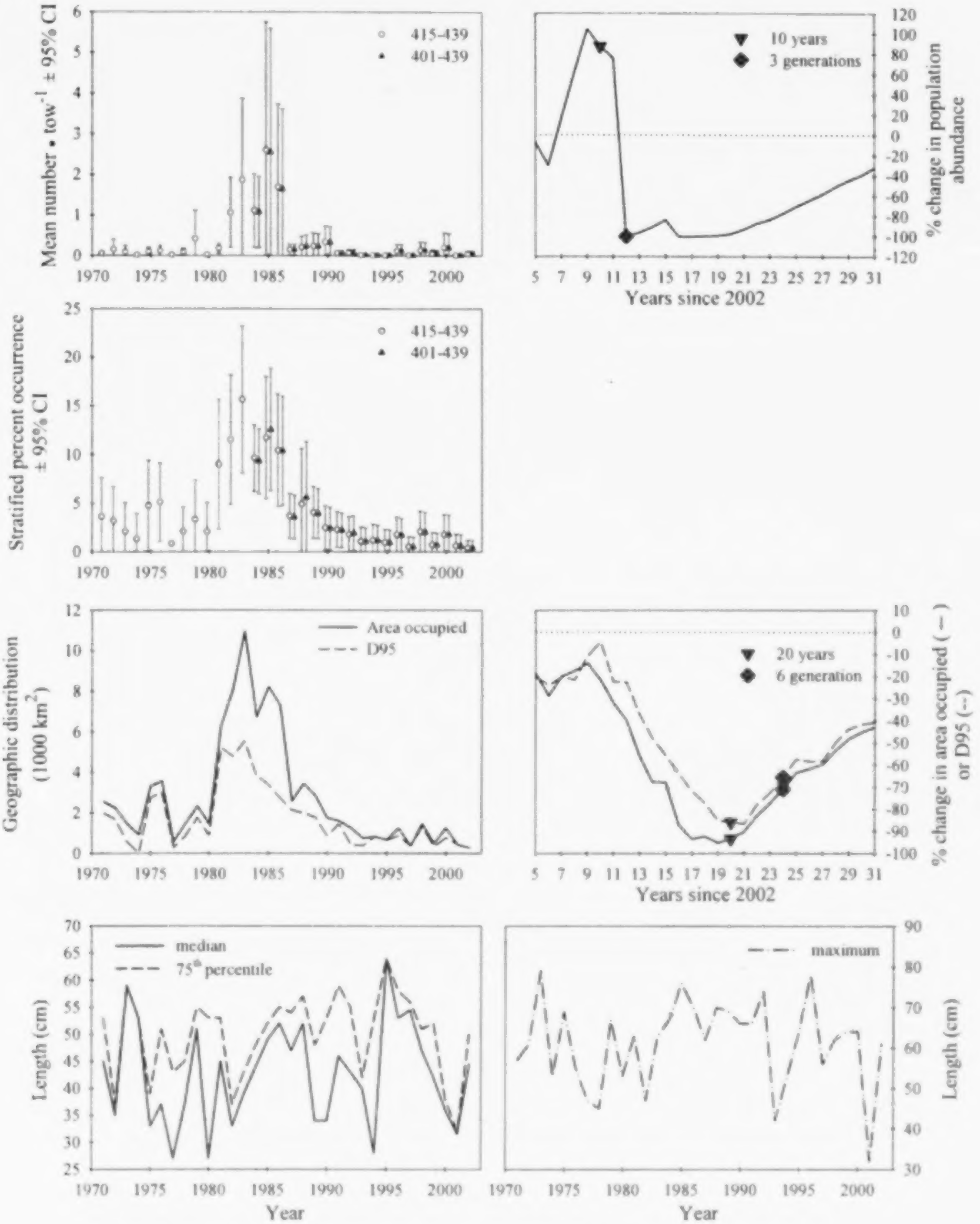

Figure 10a: Indicators of population status and distribution for haddock, *Melanogrammus aeglefinus* (1971-2002).

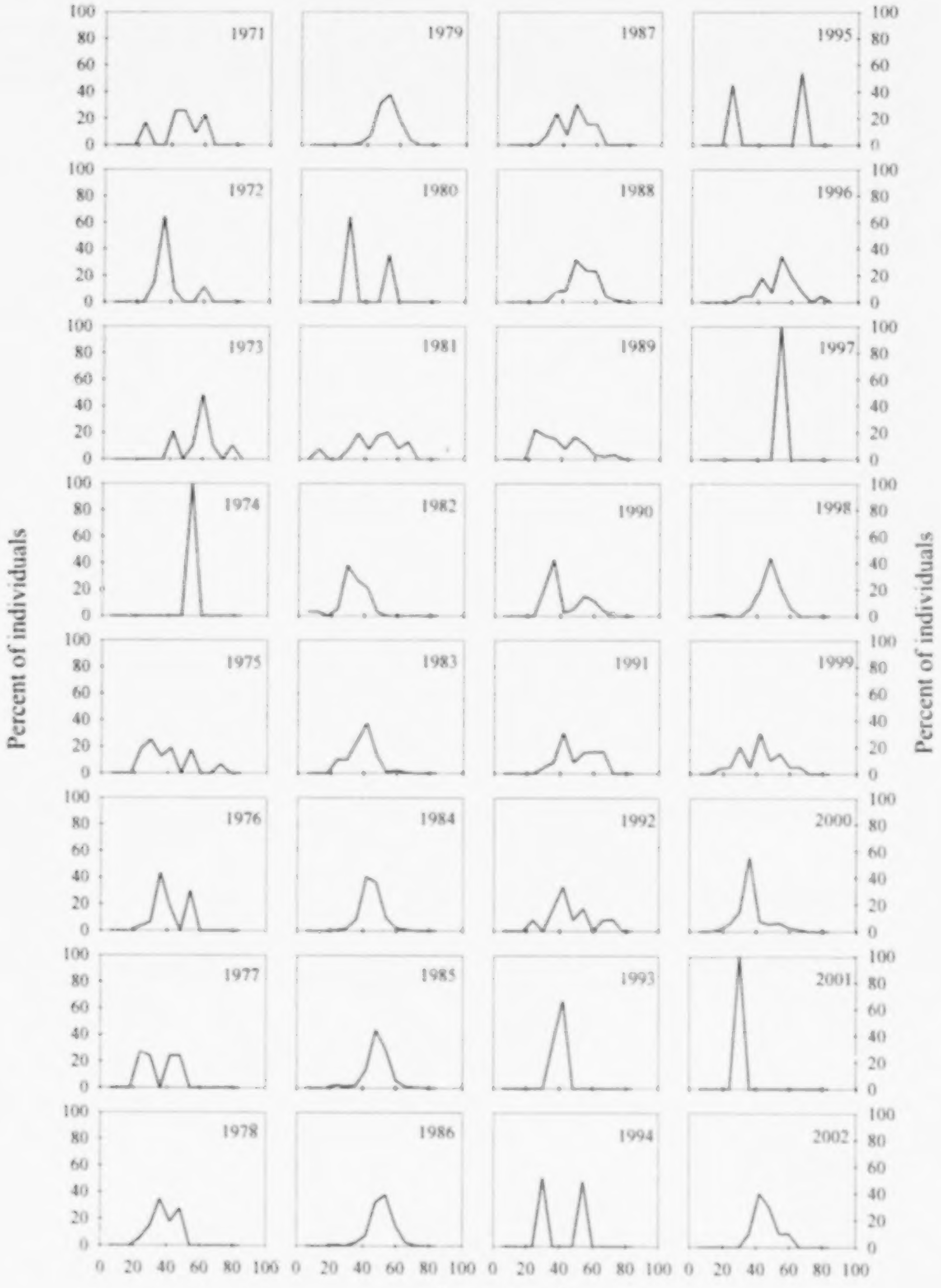

Figure 10b: Yearly length frequency distributions for haddock (*Melanogrammus aeglefinus*).

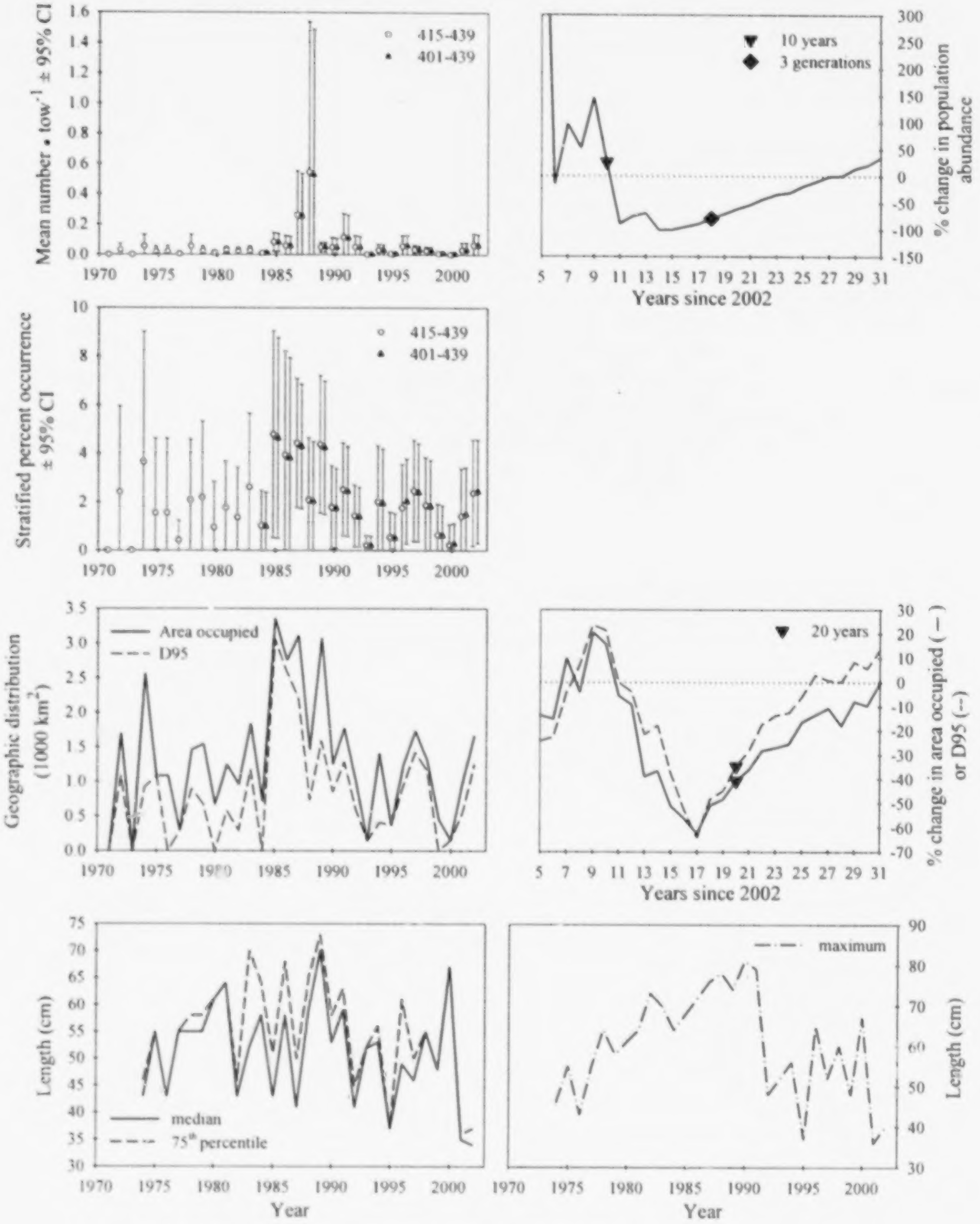

Figure 11a: Indicators of population status and distribution for pollock, *Pollachius virens* (1971-2002).

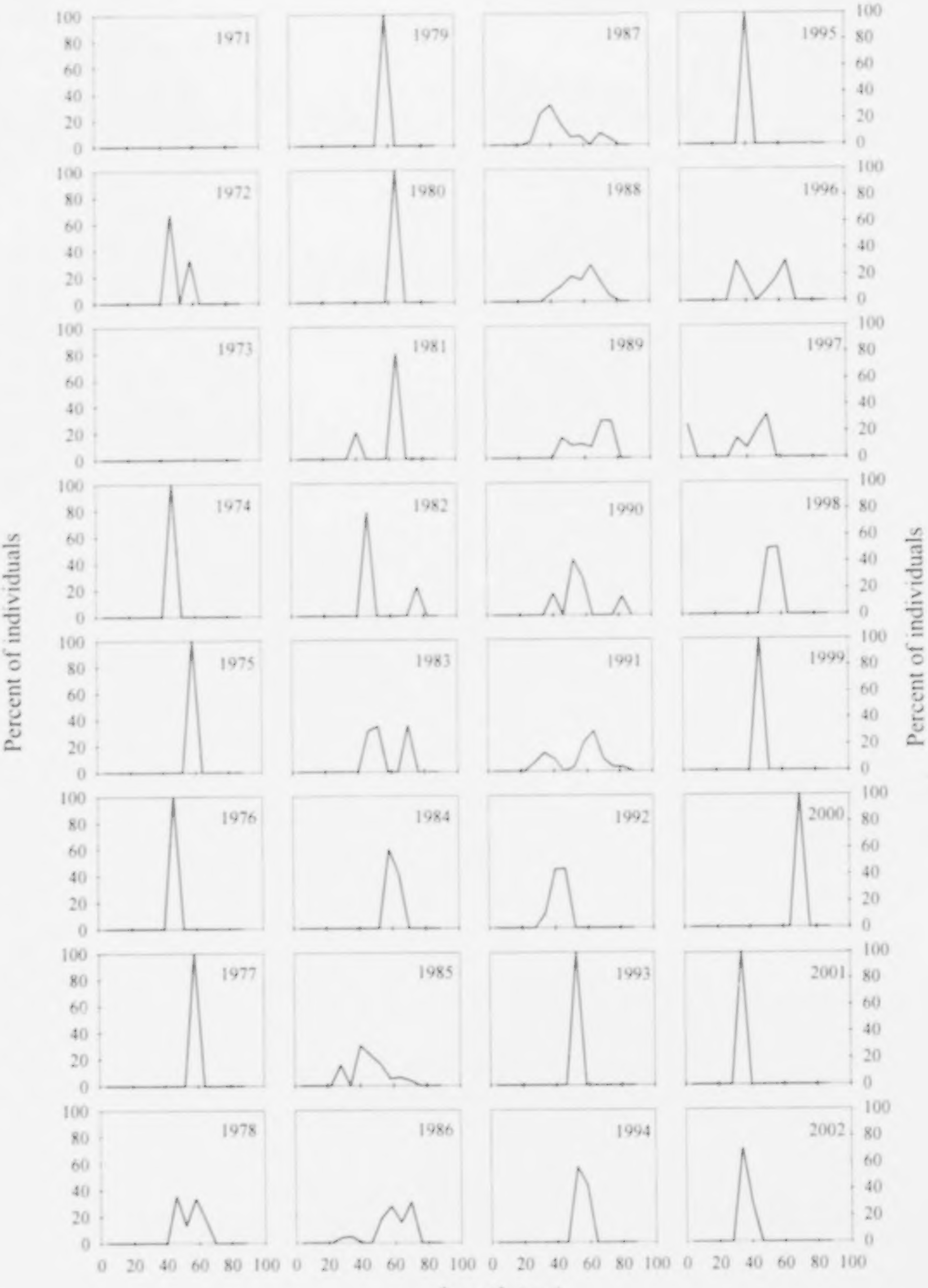

Figure 11b: Yearly length frequency distributions for pollock (*Pollachius virens*).

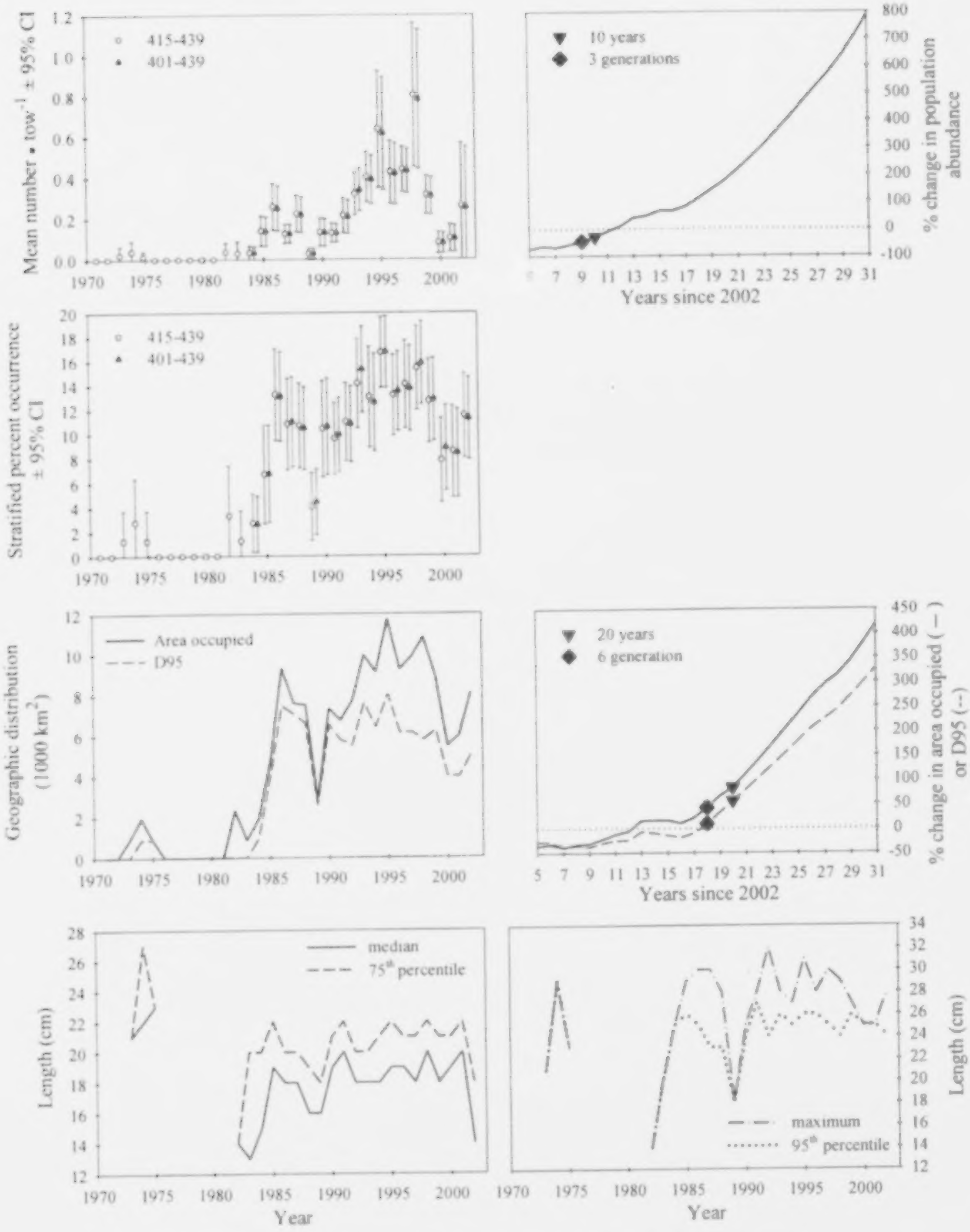

Figure 12a: Indicators of population status and distribution for fourbeard rockling, *Enchelyopus cimbrius* (1971-2002).

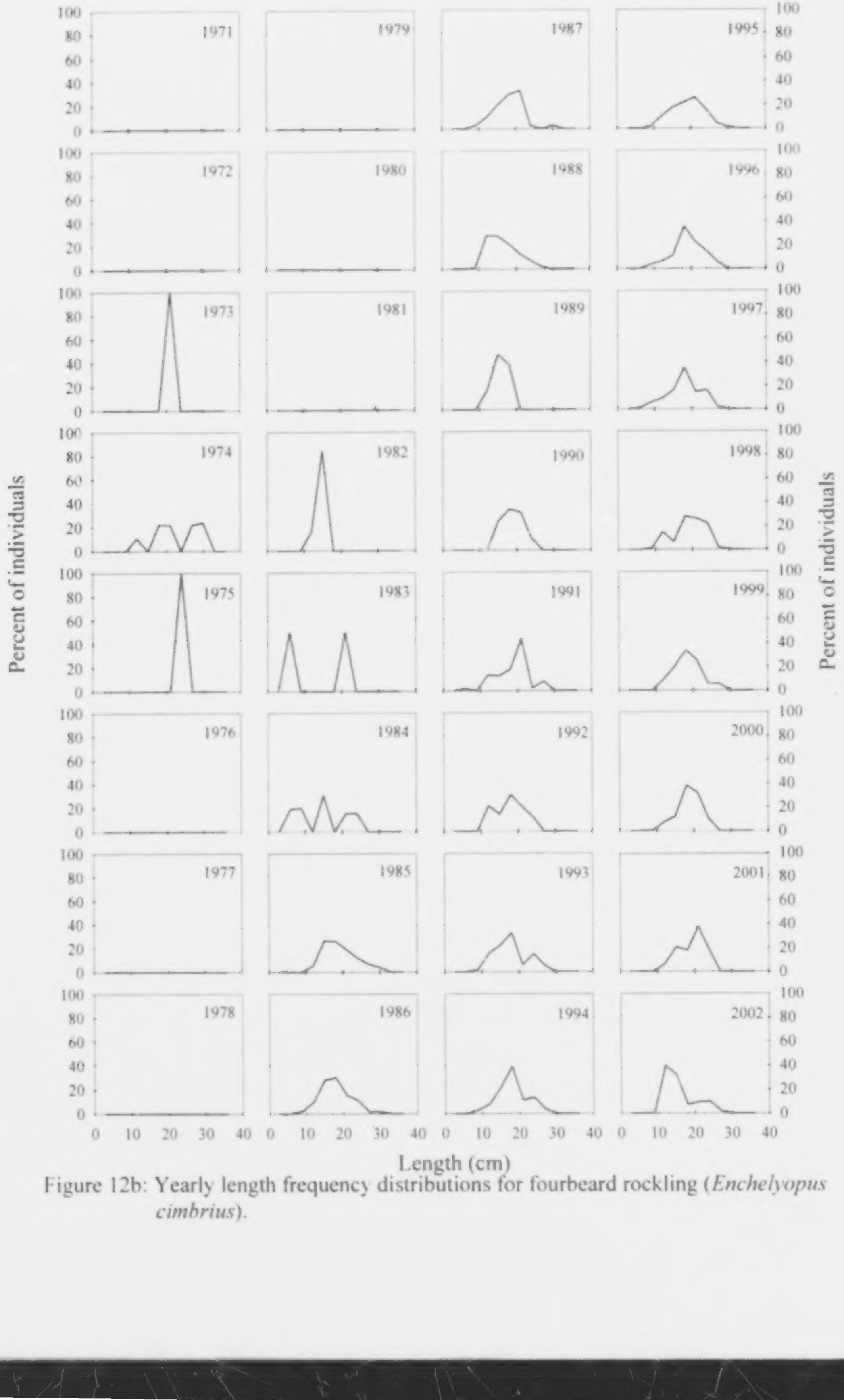

Figure 12b: Yearly length frequency distributions for fourbeard rockling (*Enchelyopus cimbrius*).

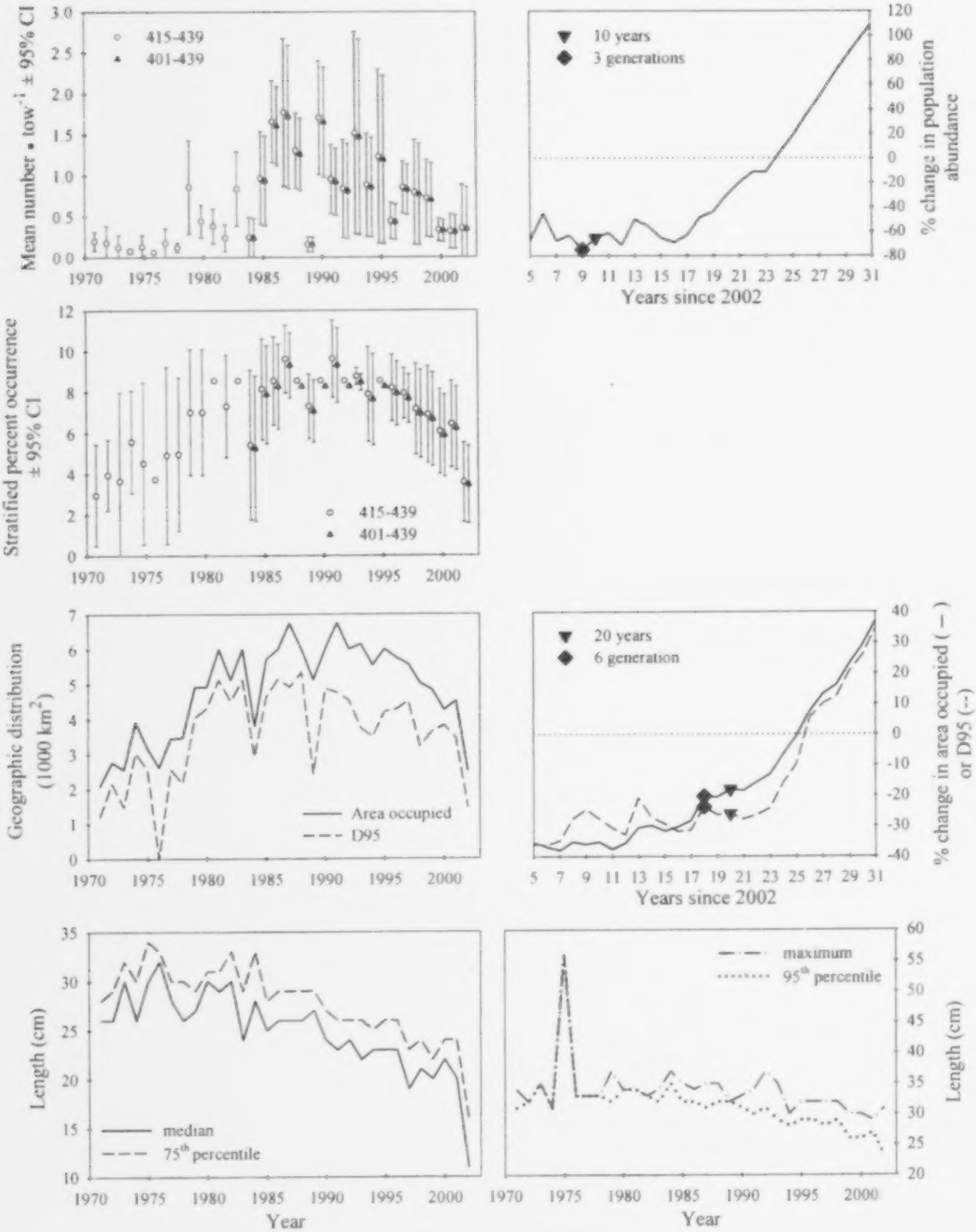

Figure 13a: Indicators of population status and distribution for marlin-spike grenadier, *Nezumia bairdii* (1971-2002).

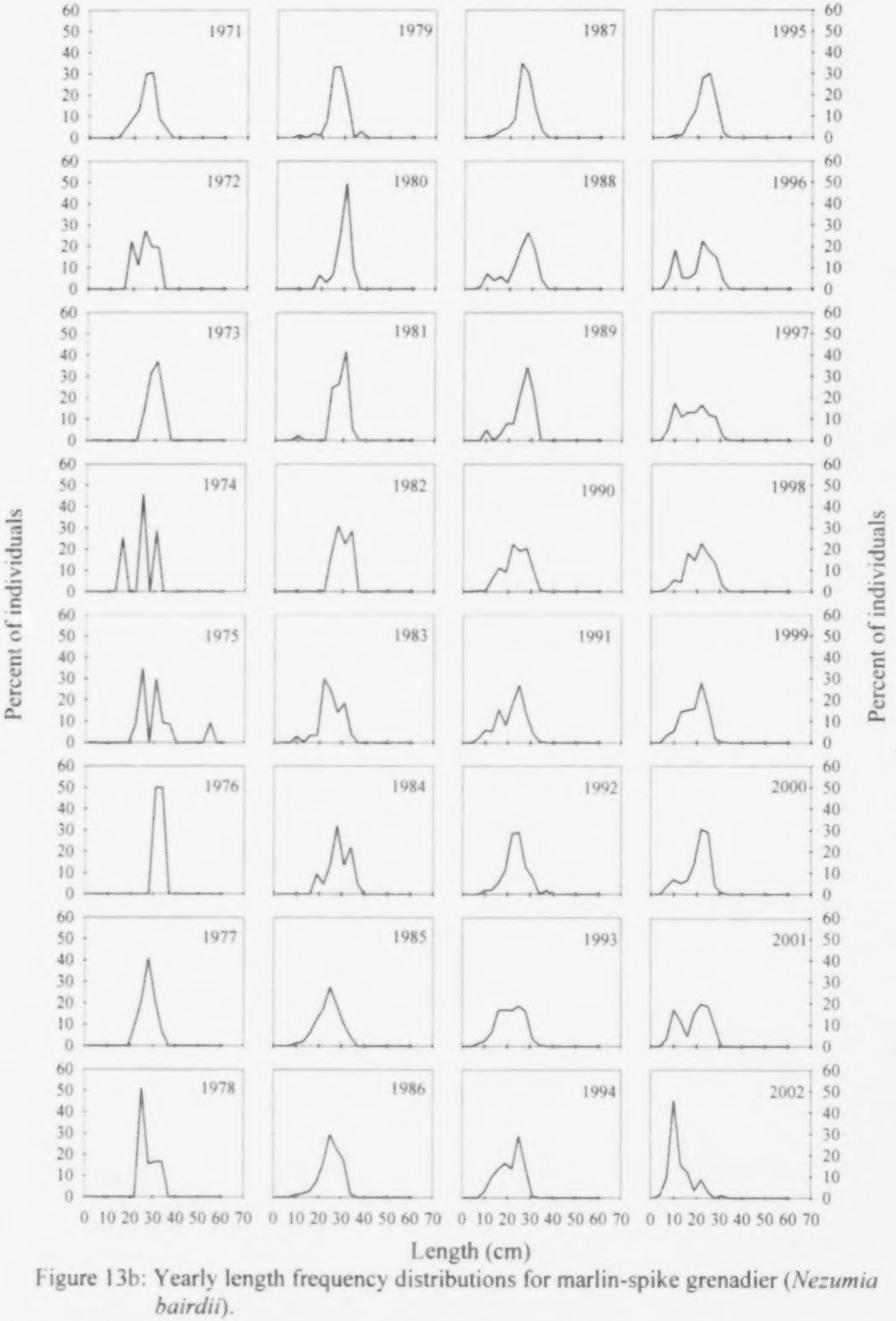

Figure 13b: Yearly length frequency distributions for marlin-spike grenadier (*Nezumia bairdii*).

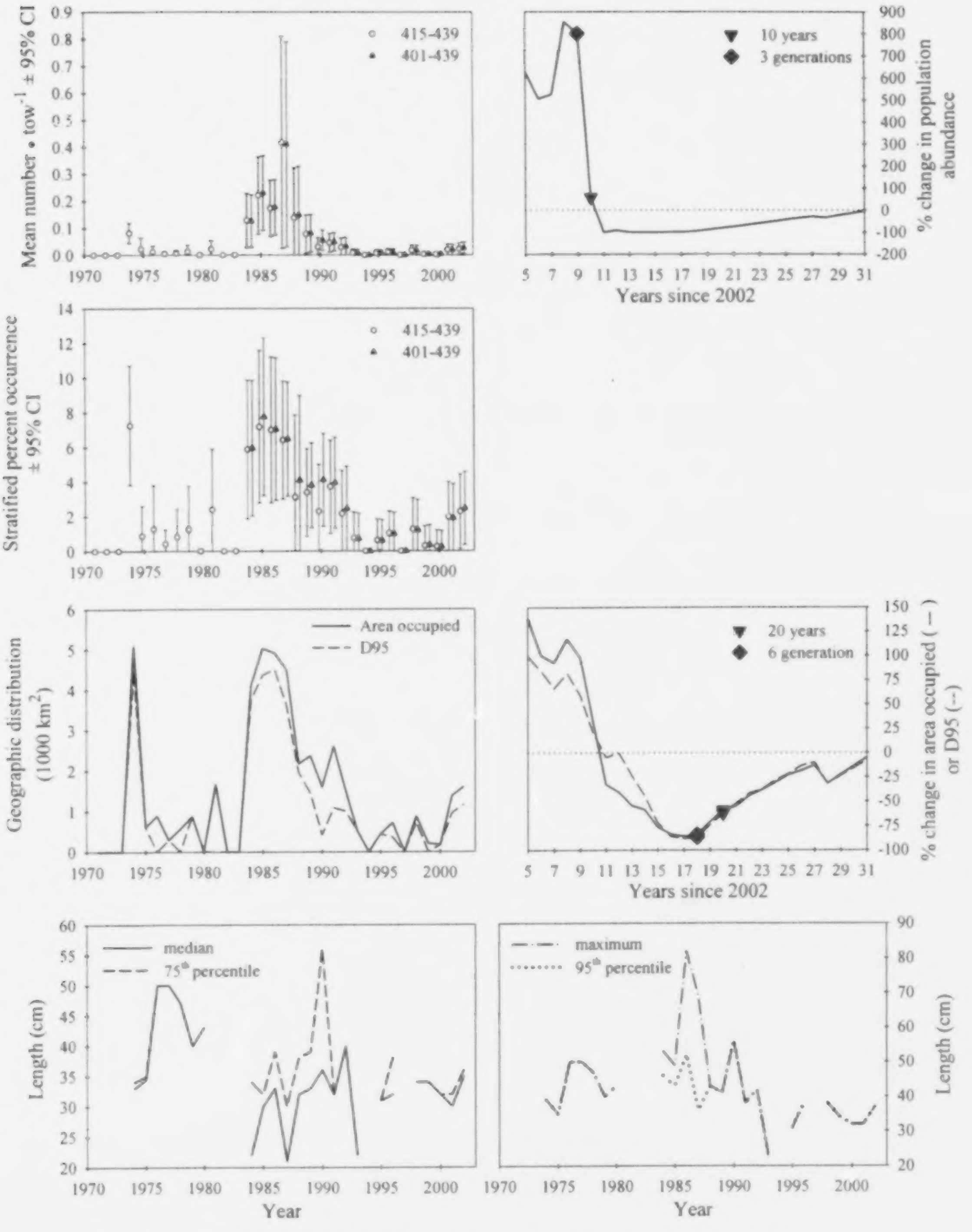

Figure 14a: Indicators of population status and distribution for silver hake, *Merluccius bilinearis* (1971-2002).

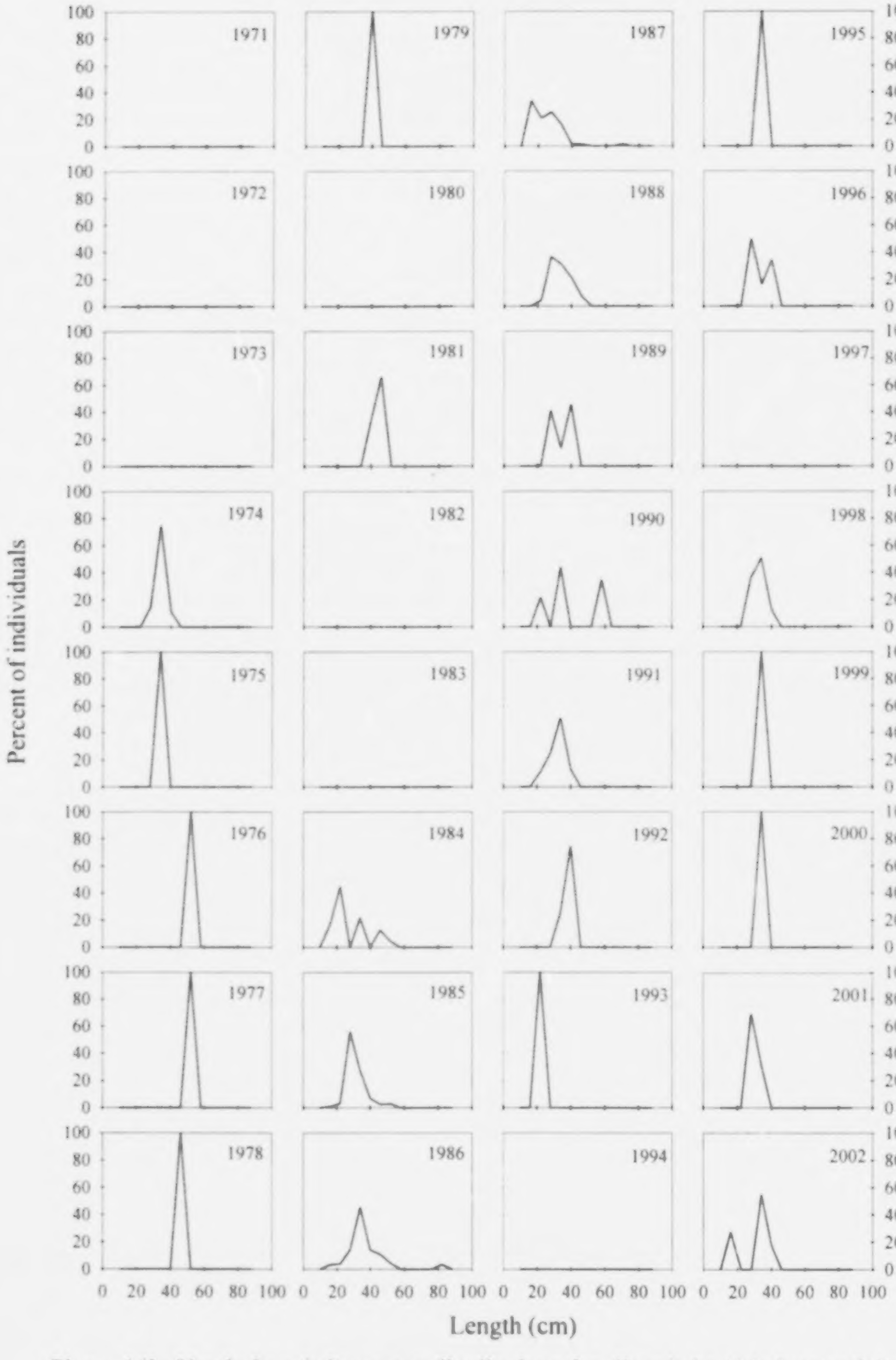

Figure 14b: Yearly length frequency distributions for silver hake (*Merluccius bilinearis*).

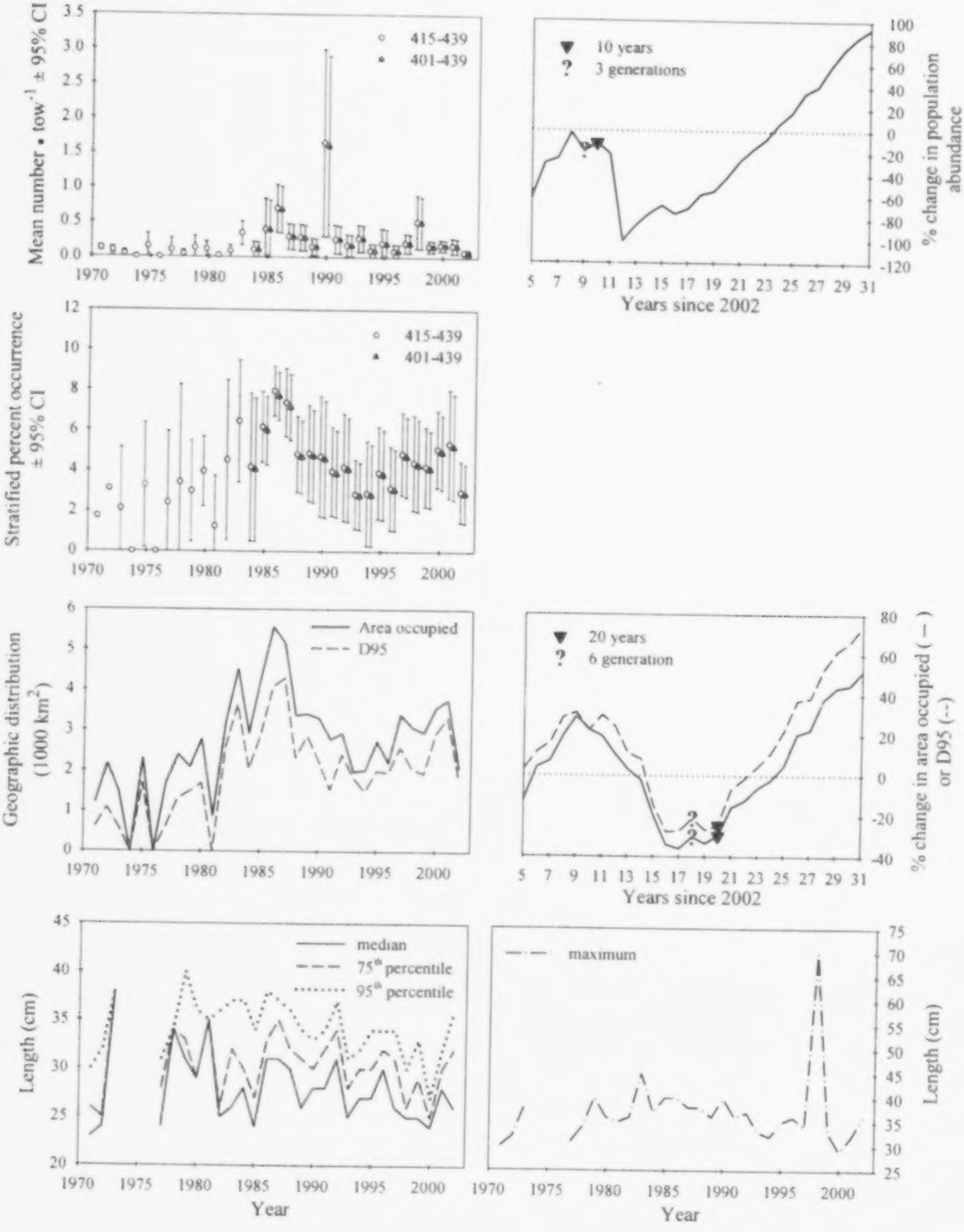

Figure 15a: Indicators of population status and distribution for longfin hake, *Phycis chesteri* (1971-2002).

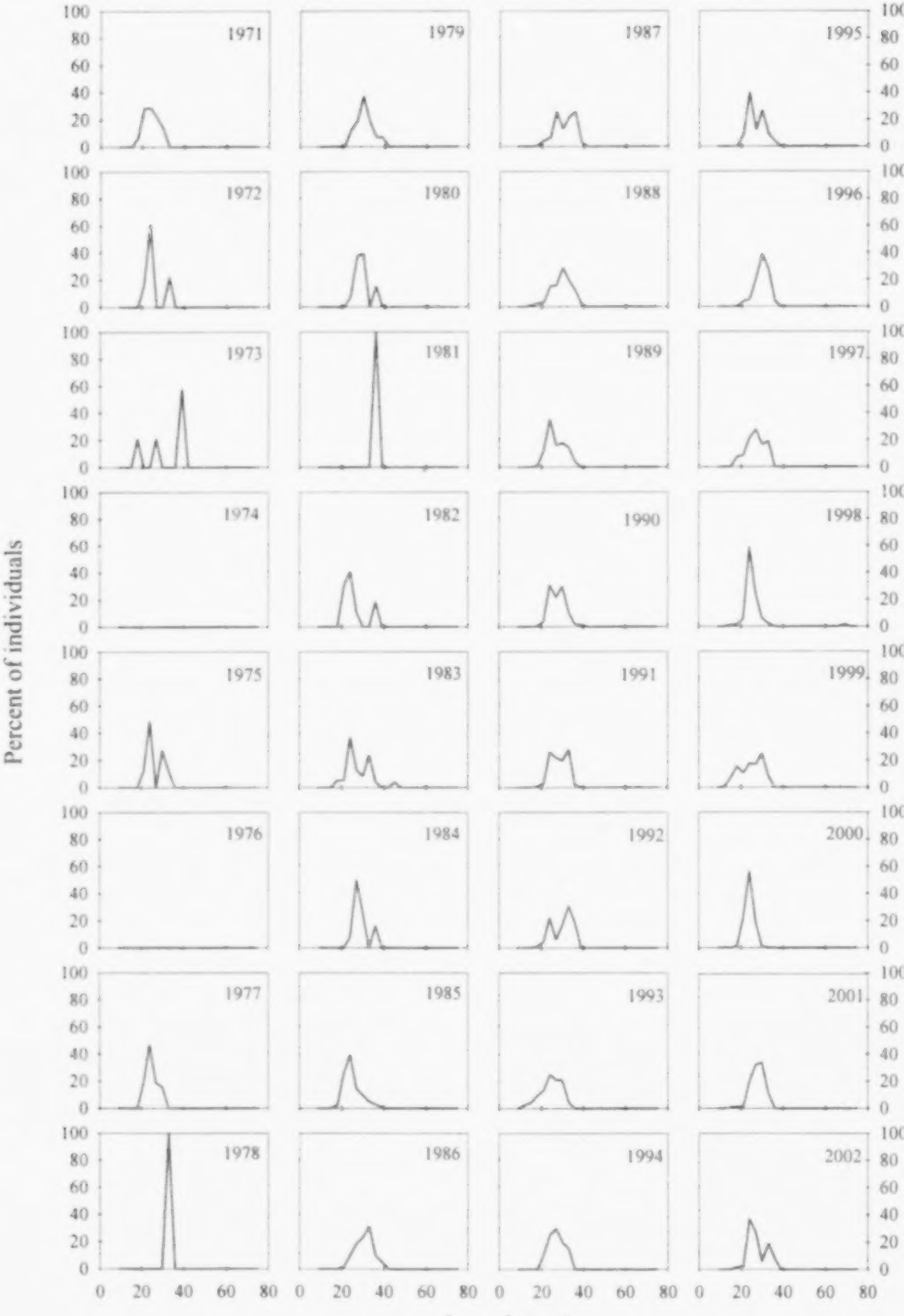

Figure 15b: Yearly length frequency distributions for longfin hake (*Phycis chesteri*).

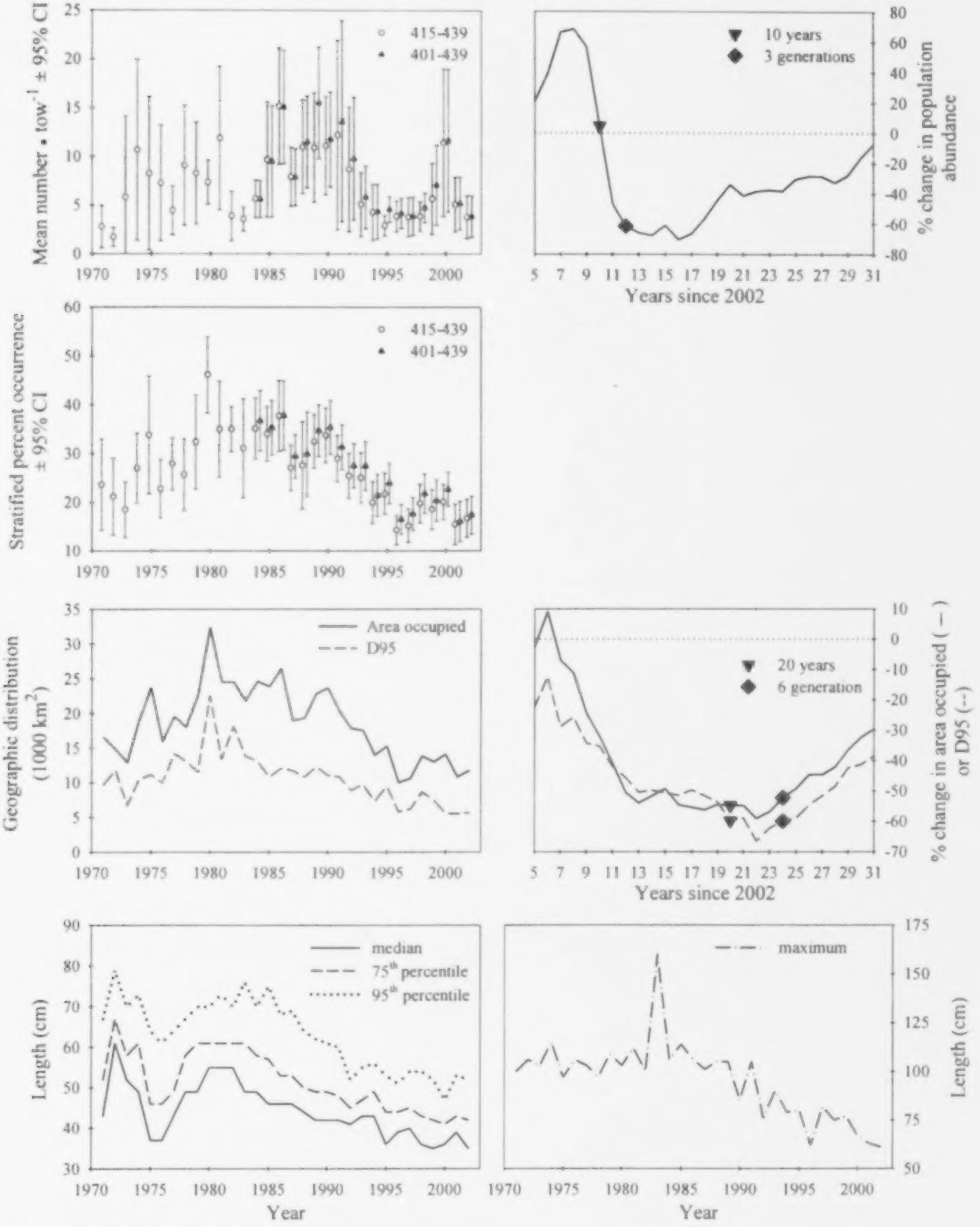

Figure 16a: Indicators of population status and distribution for white hake, *Urophycis tenuis* (1971-2002).

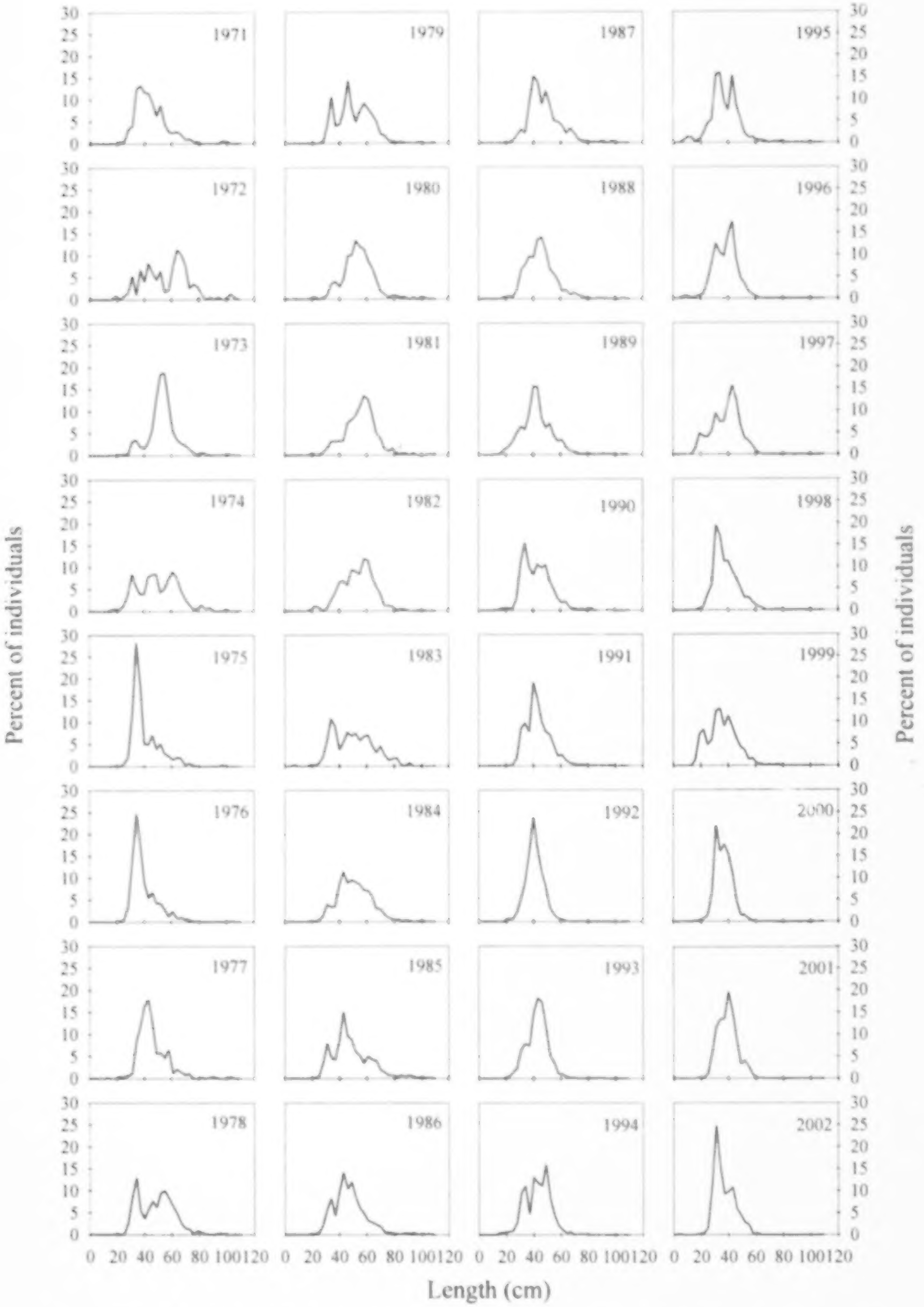

Figure 16b: Yearly length frequency distributions for white hake (*Urophycis tenuis*).

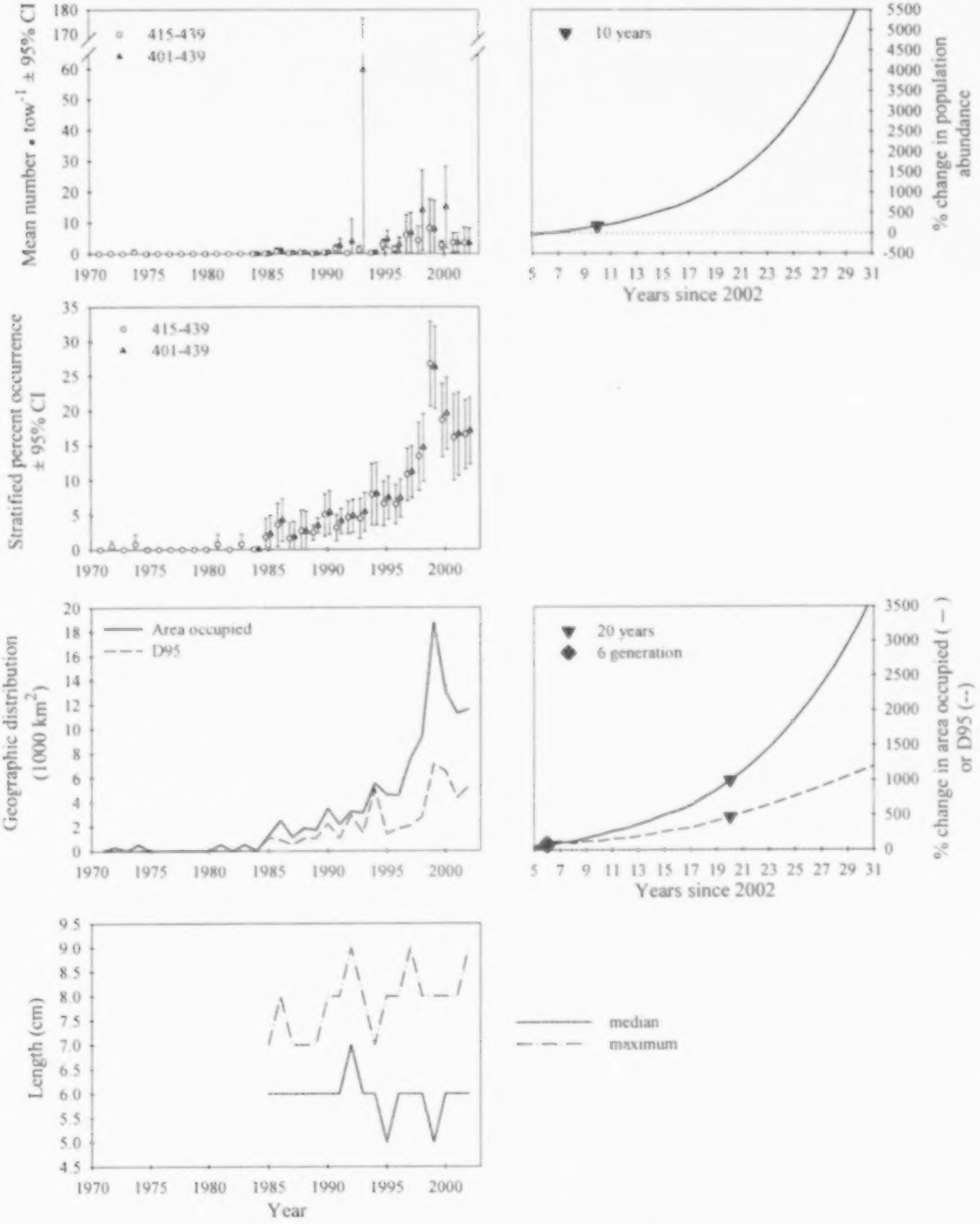

Figure 17a: Indicators of population status and distribution for threespine stickleback, *Gasterosteus aculeatus aculeatus* (1971-2002).

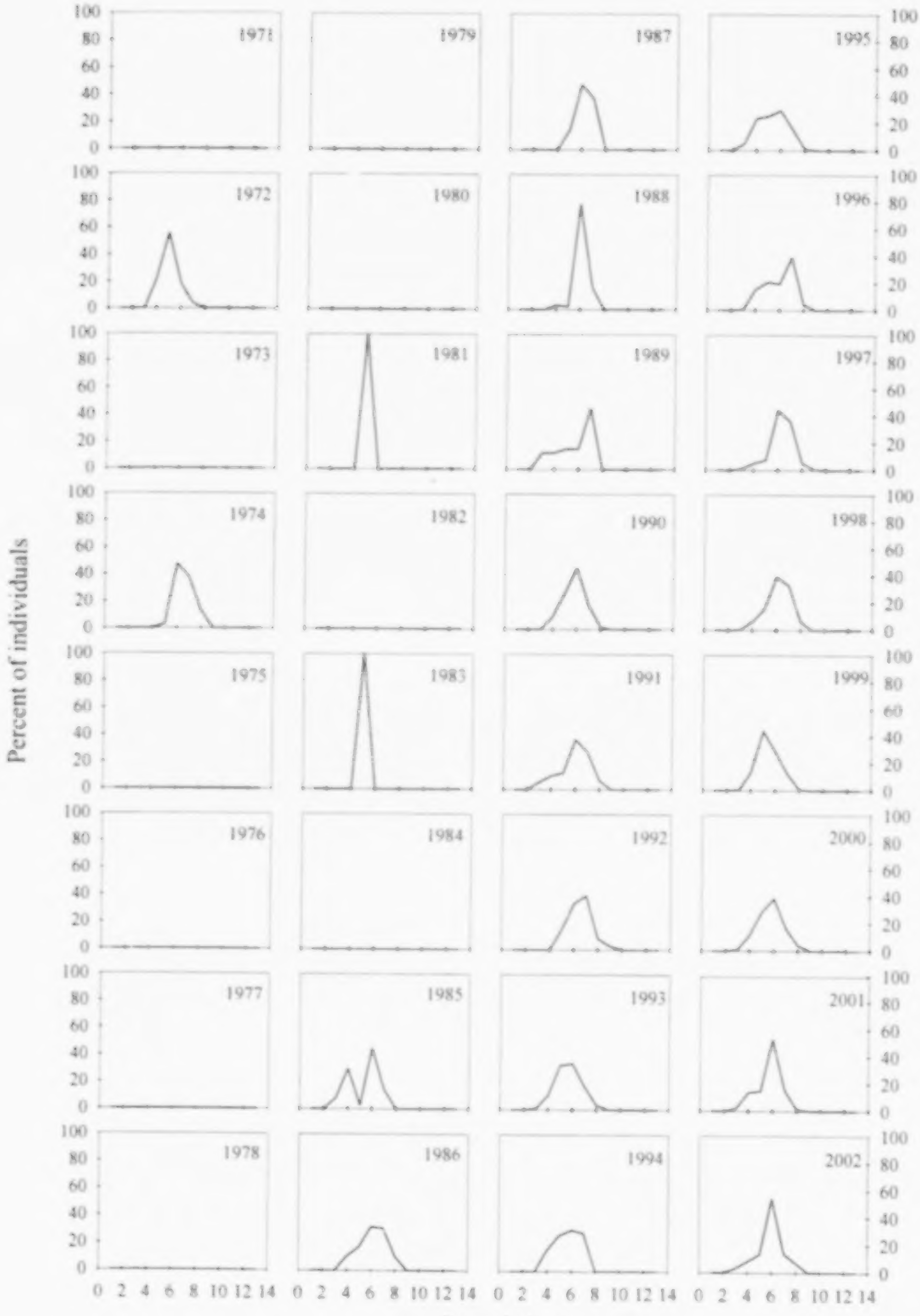

Figure 17b: Yearly length frequency distributions for threespine stickleback (*Gasterosteus aculeatus aculeatus*).

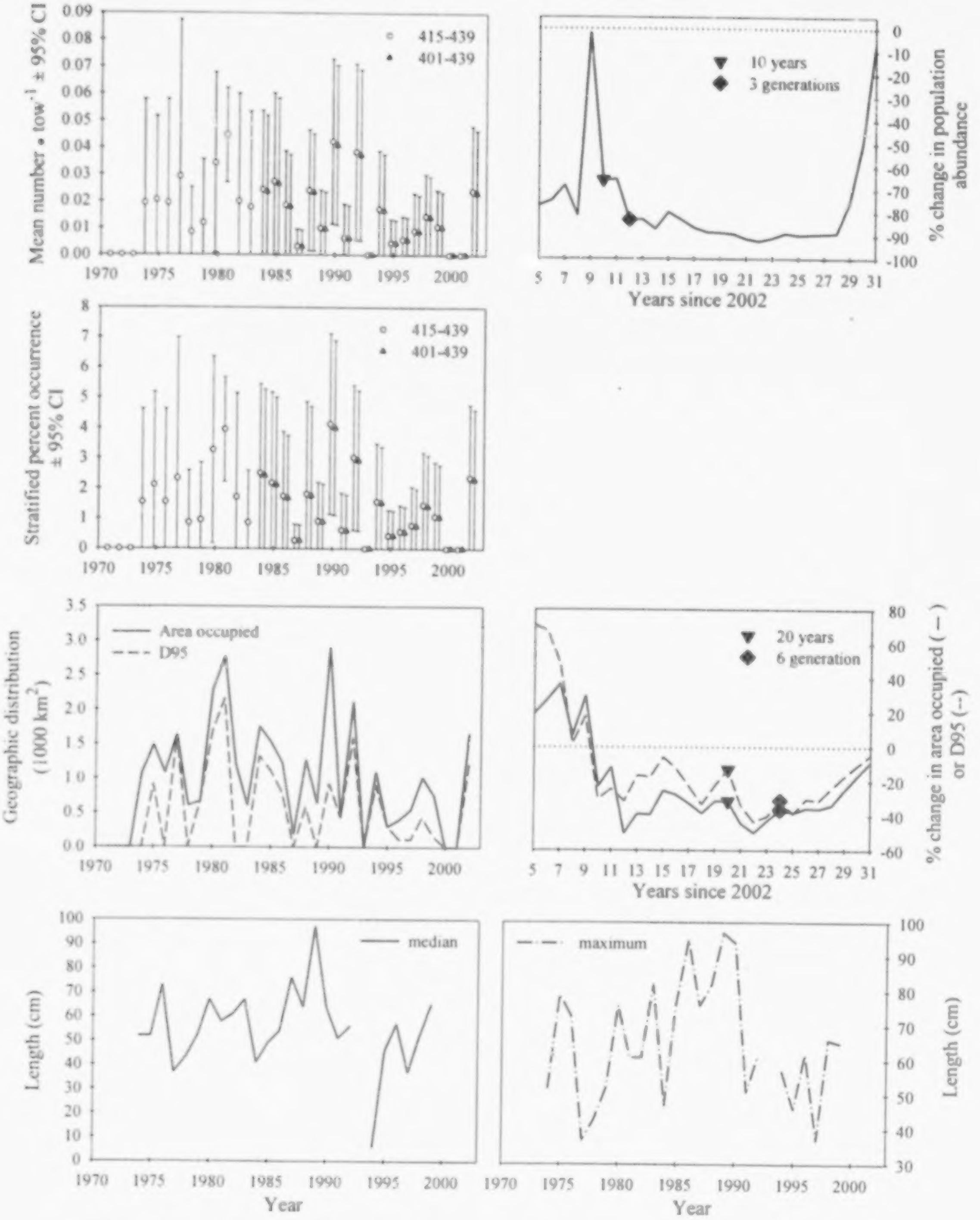

Figure 18a: Indicators of population status and distribution for monkfish / goosefish, *Lophius americanus* (1971-2002).

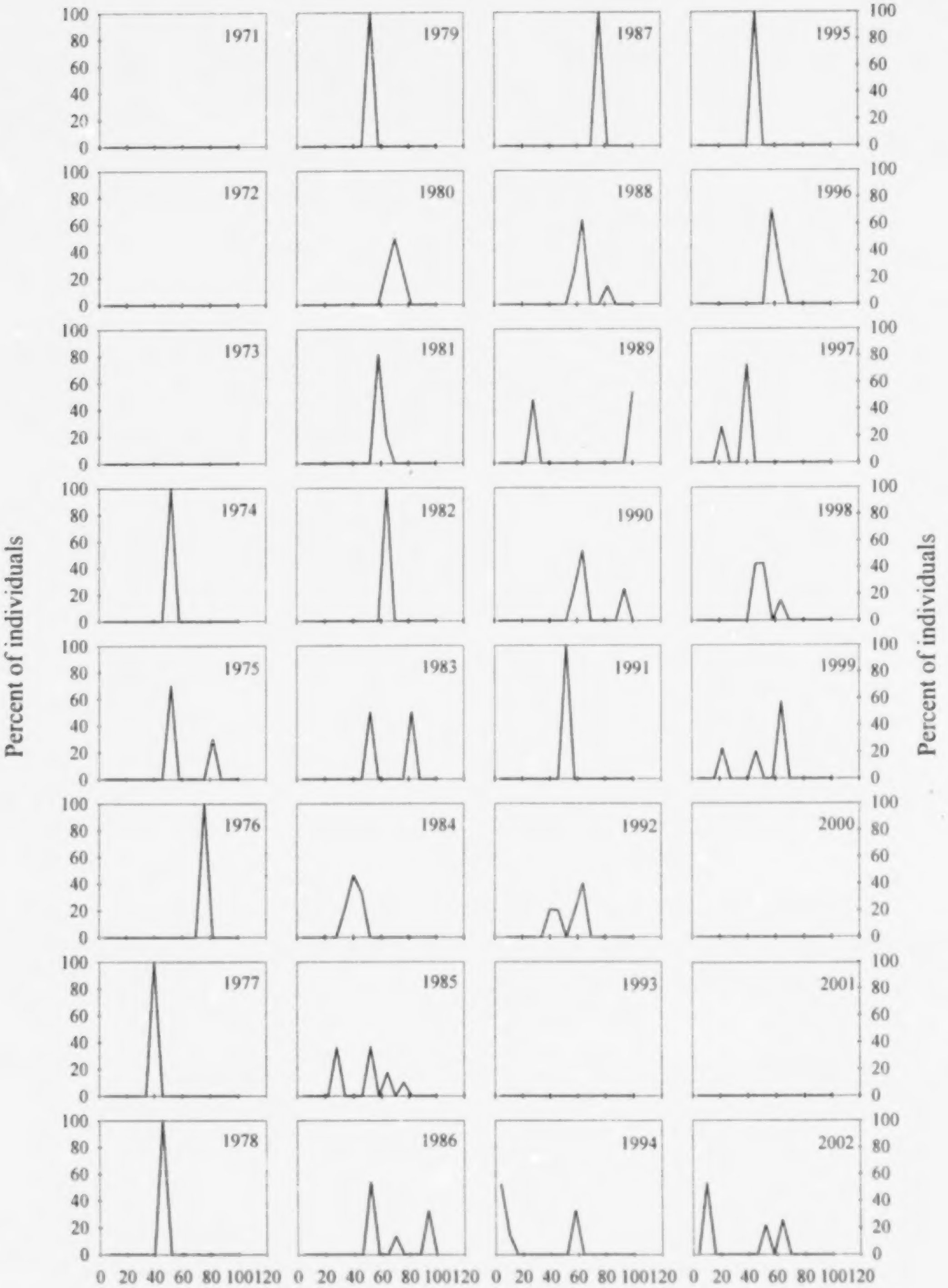

Figure 18b: Yearly length frequency distributions for monkfish / goosefish (*Lophius americanus*).

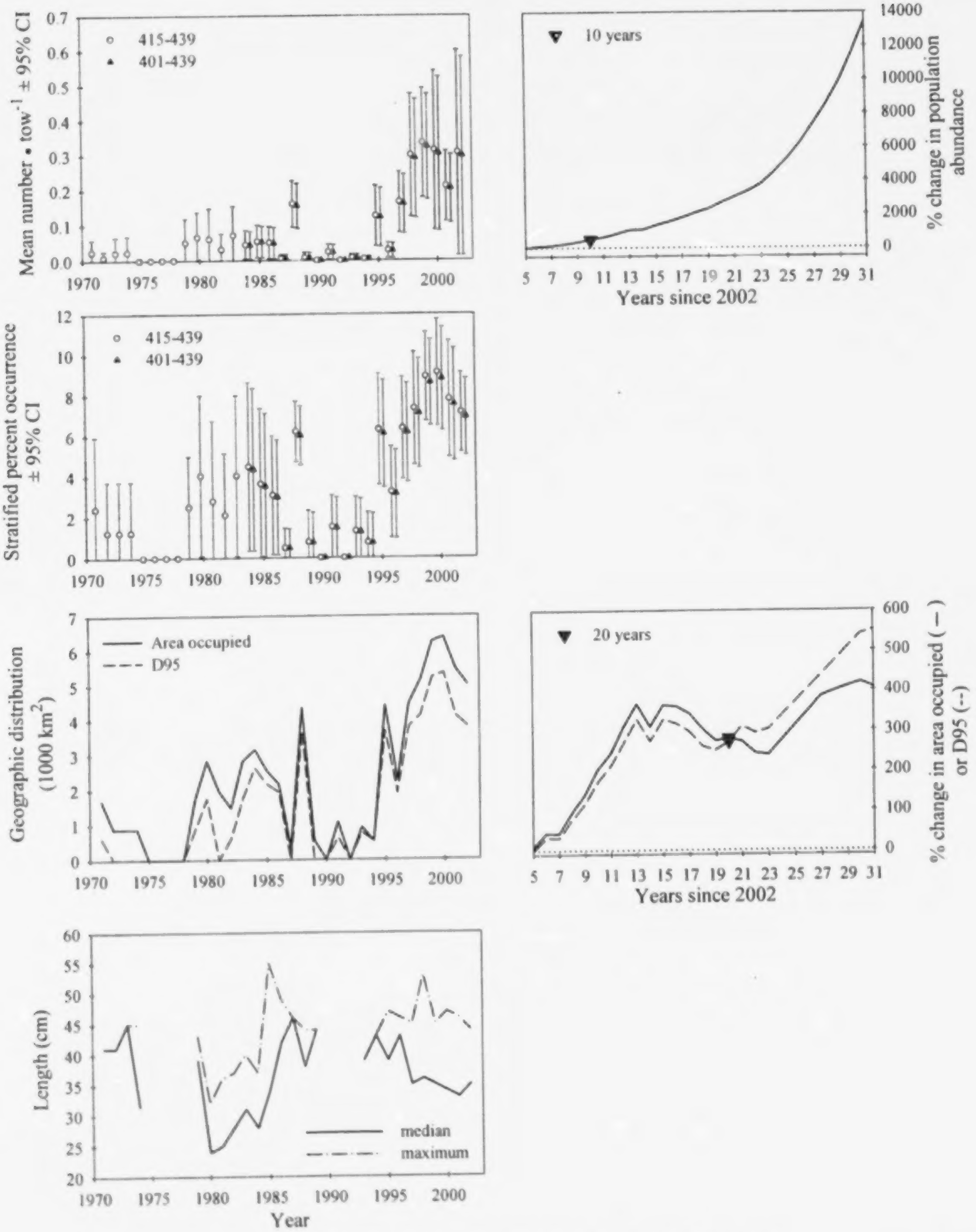

Figure 19a: Indicators of population status and distribution for Atlantic hagfish, *Myxine glutinosa* (1971-2002).

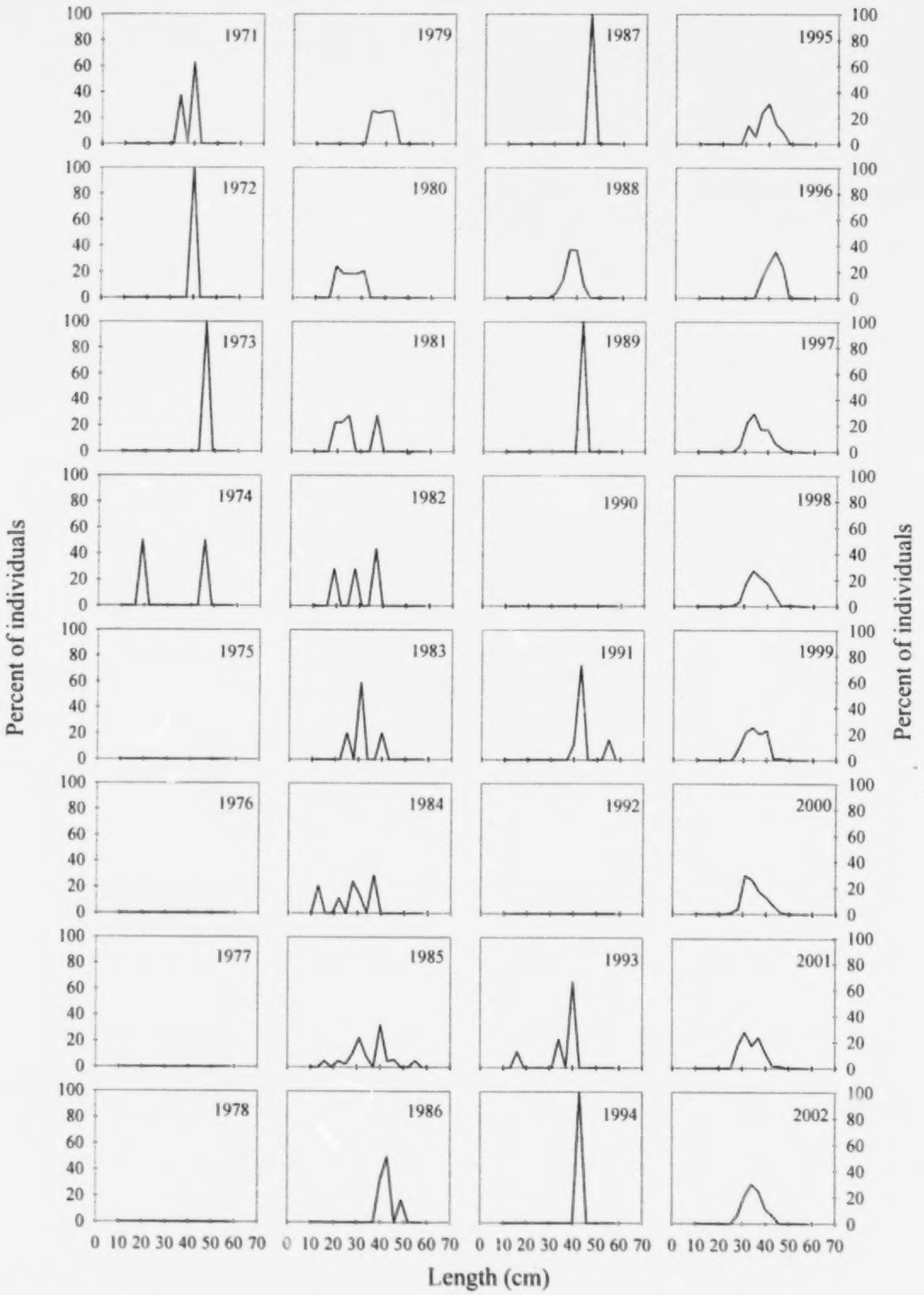

Figure 19b: Yearly length frequency distributions for Atlantic hagfish (*Myxine glutinosa*).

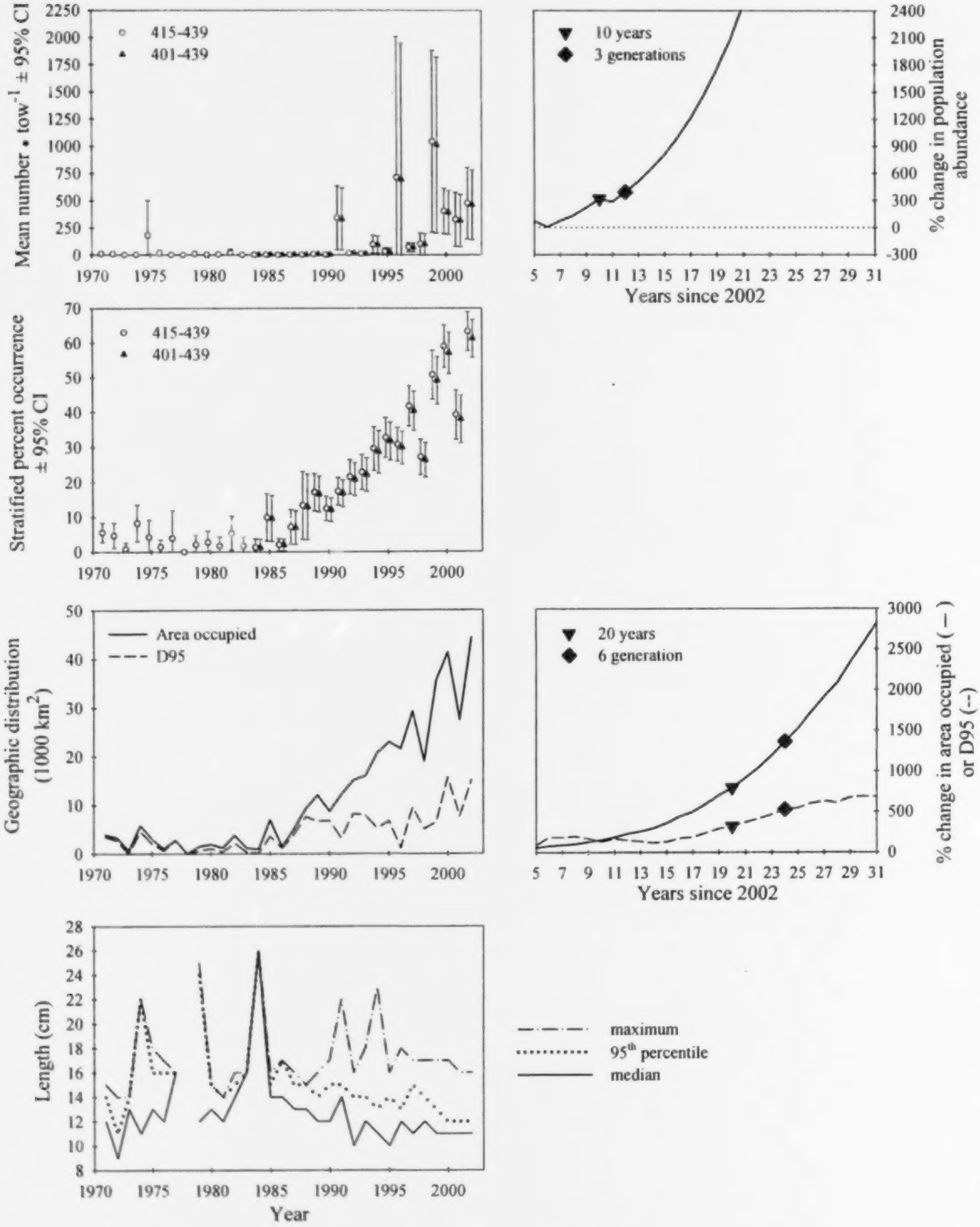

Figure 20a: Indicators of population status and distribution for capelin, *Mallotus villosus* (1971-2002).

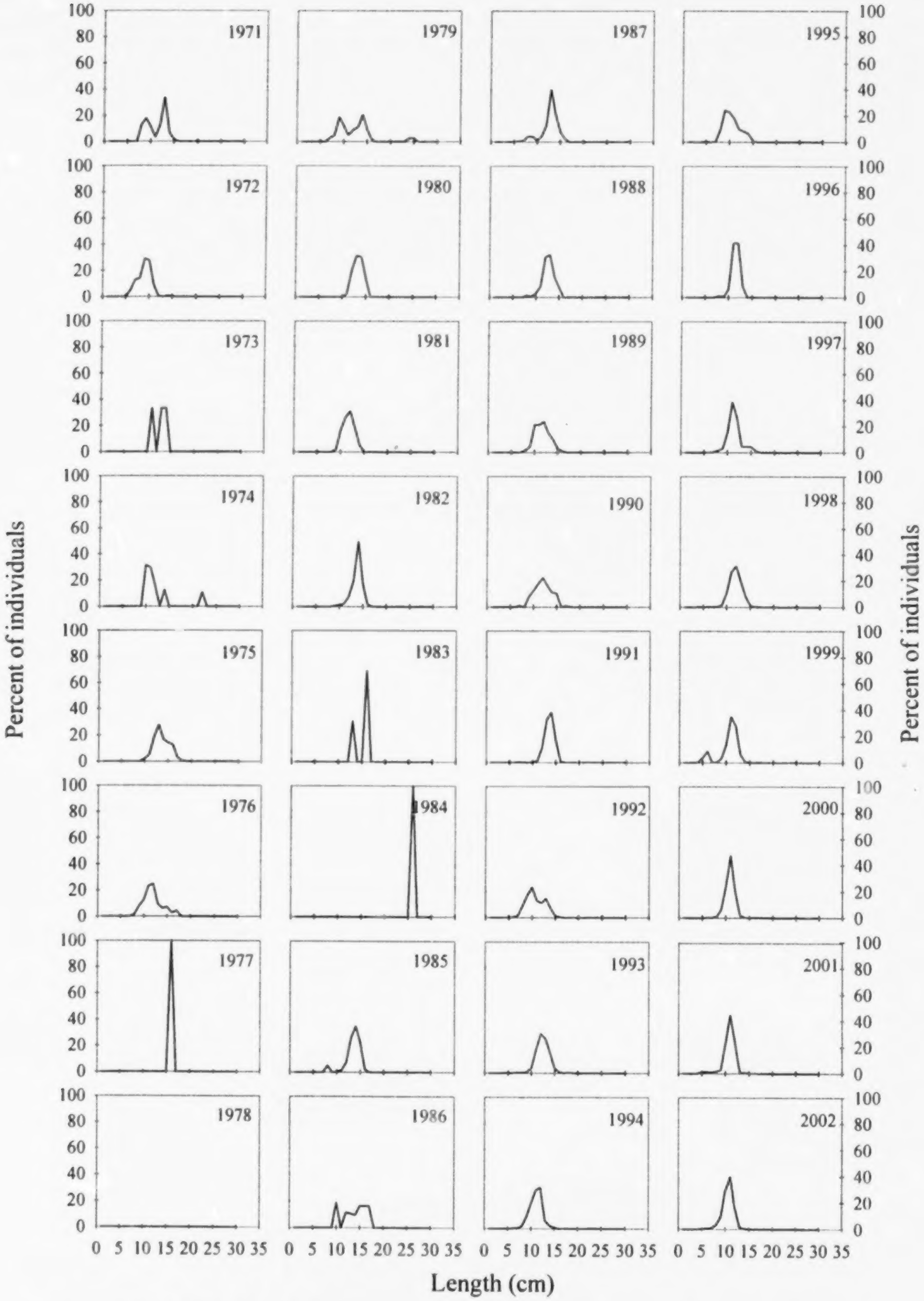

Figure 20b: Yearly length frequency distributions for capelin (*Mallotus villosus*).

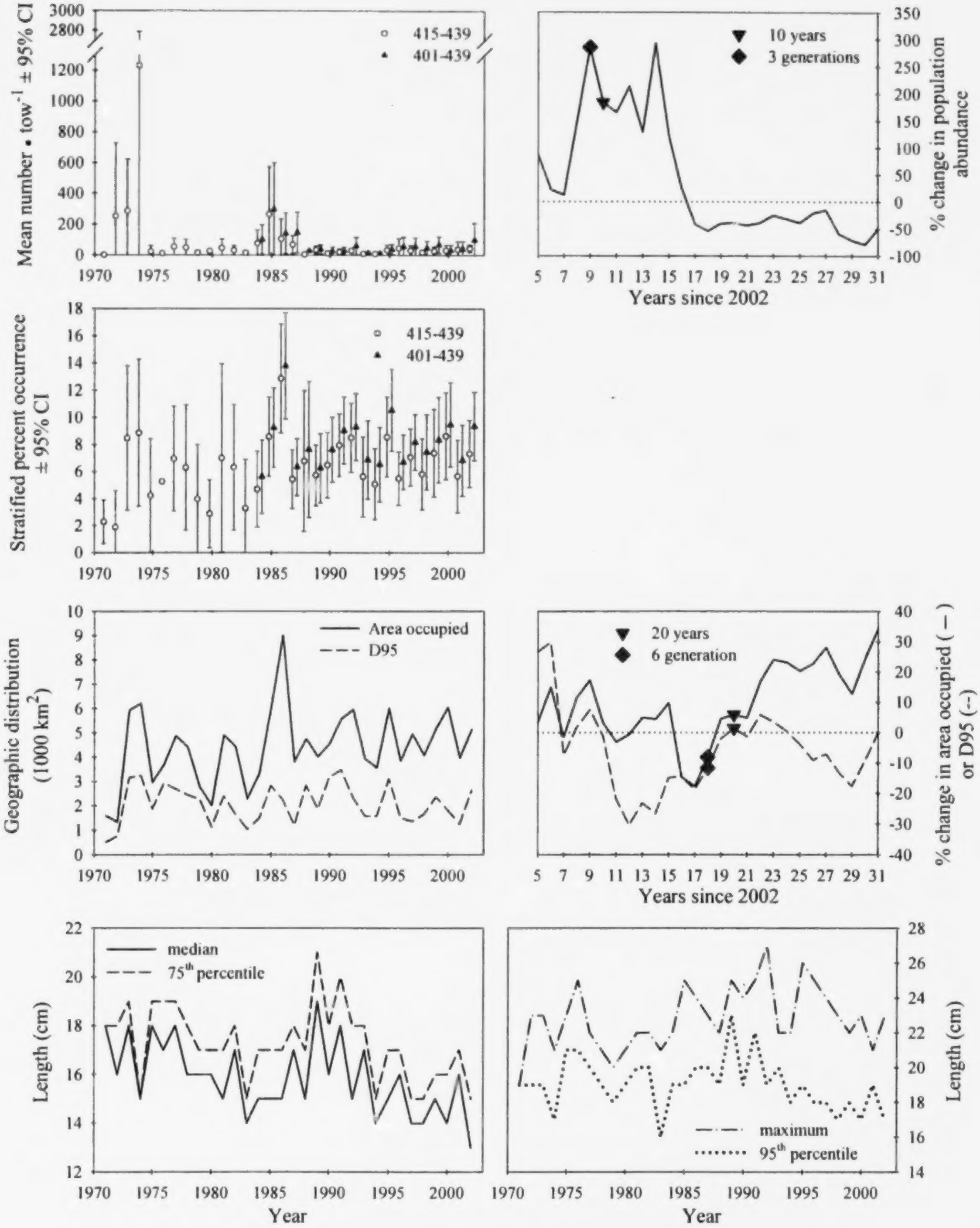

Figure 21a: Indicators of population status and distribution for rainbow smelt, *Osmerus mordax mordax* (1971-2002).

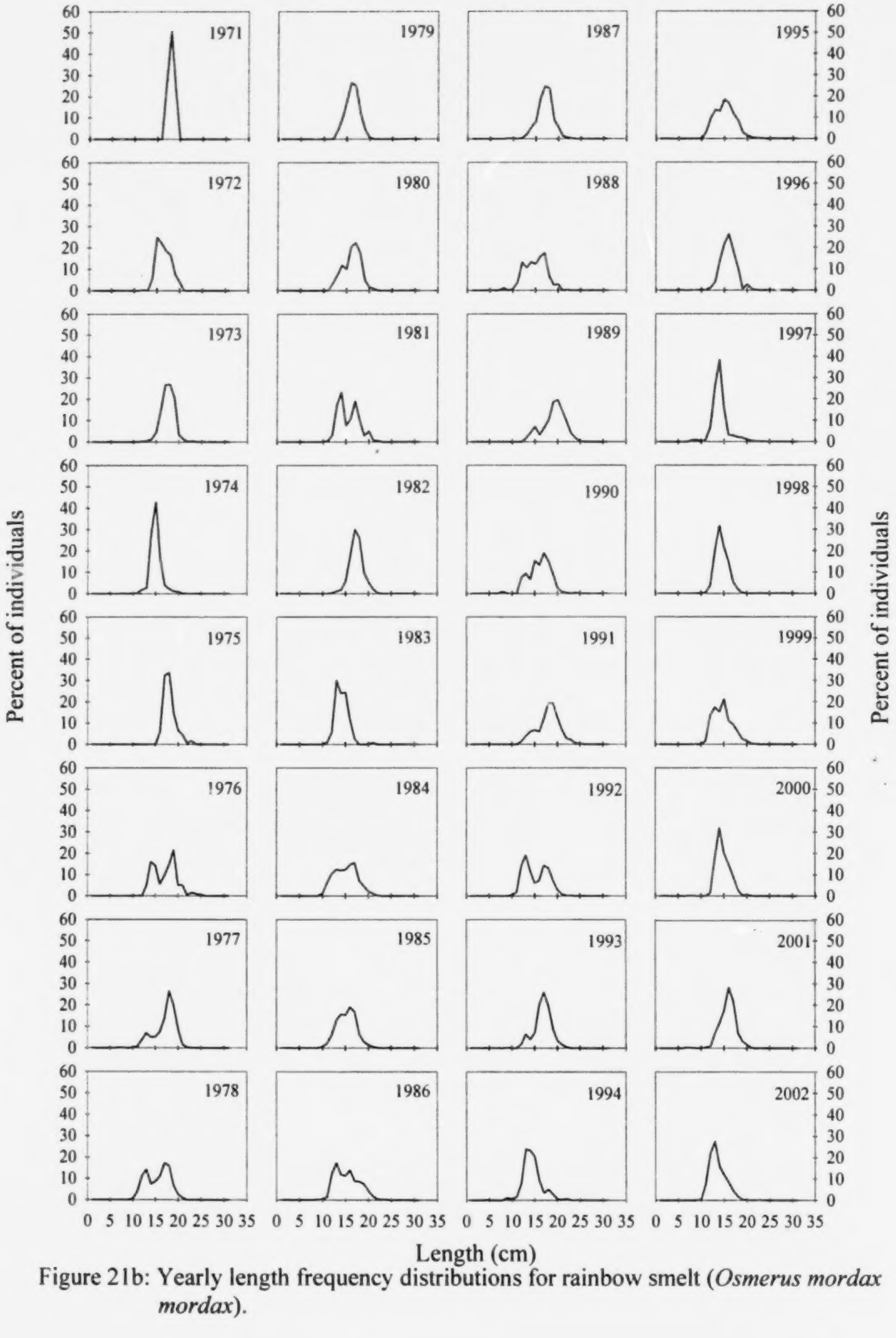

Figure 21b: Yearly length frequency distributions for rainbow smelt (*Osmerus mordax mordax*).

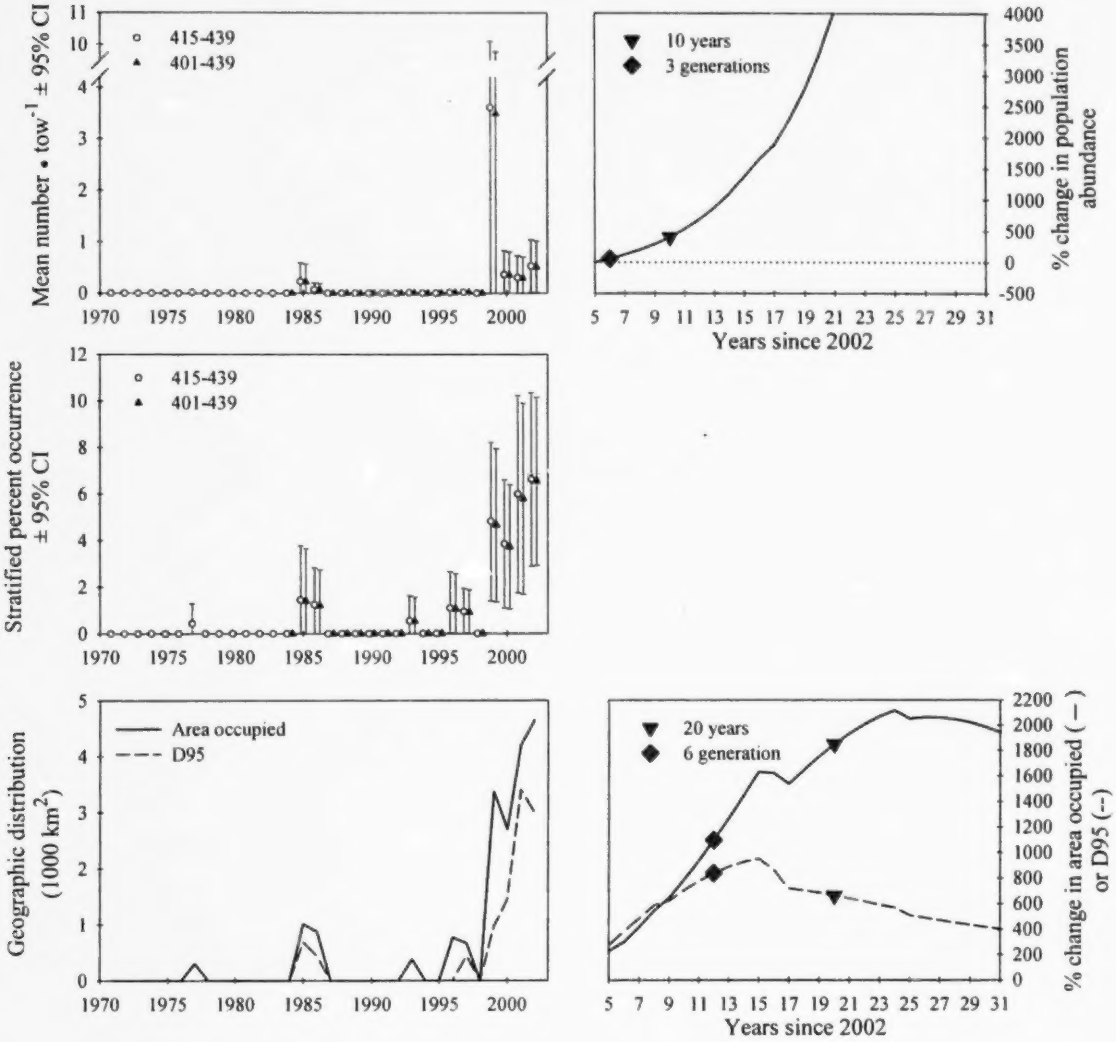

Figure 22a: Indicators of population status and distribution for northern sand lance, *Ammodytes dubius* (1971-2002).

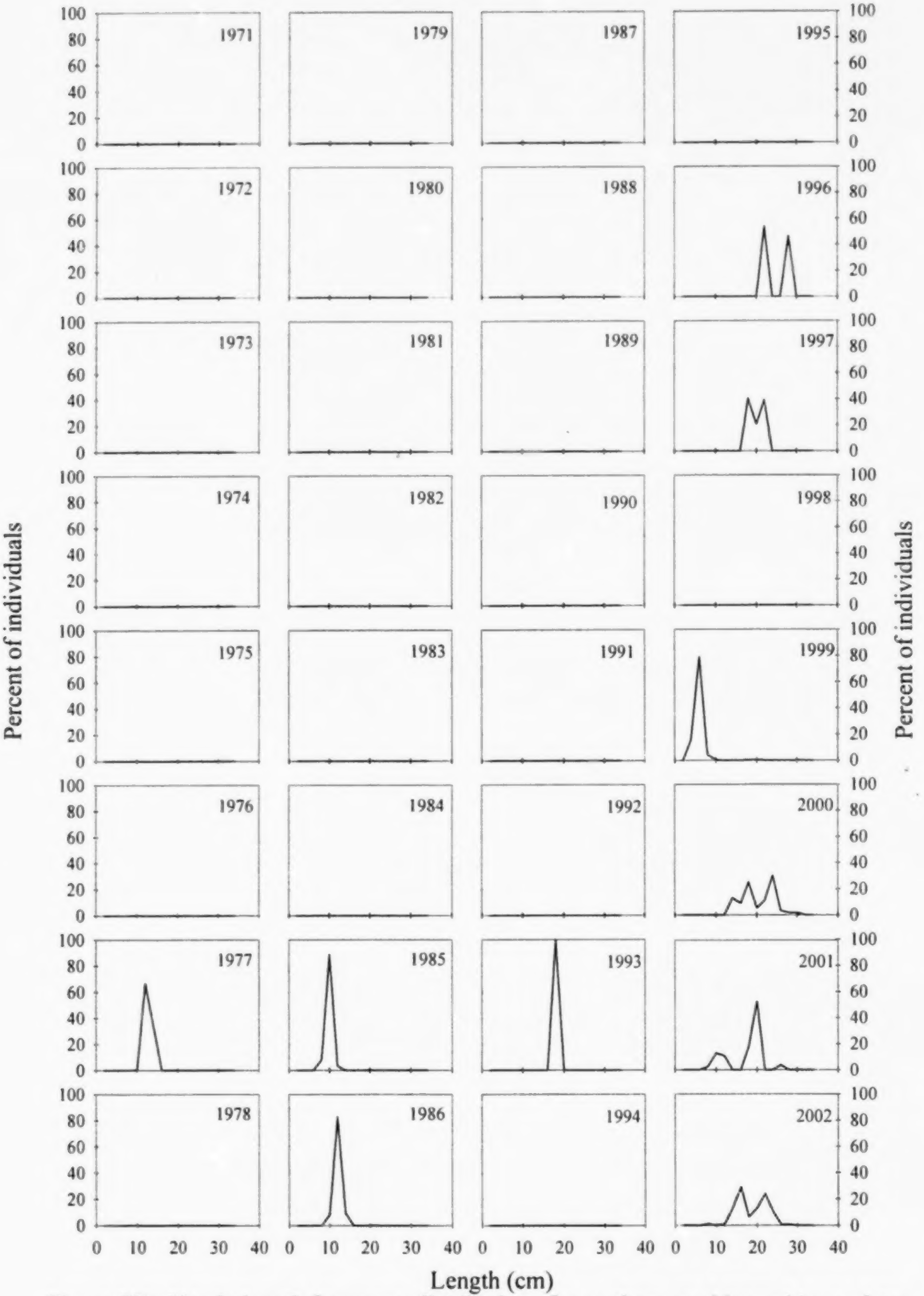

Figure 22b: Yearly length frequency distributions for northern sand lance (*Ammodytes dubius*).

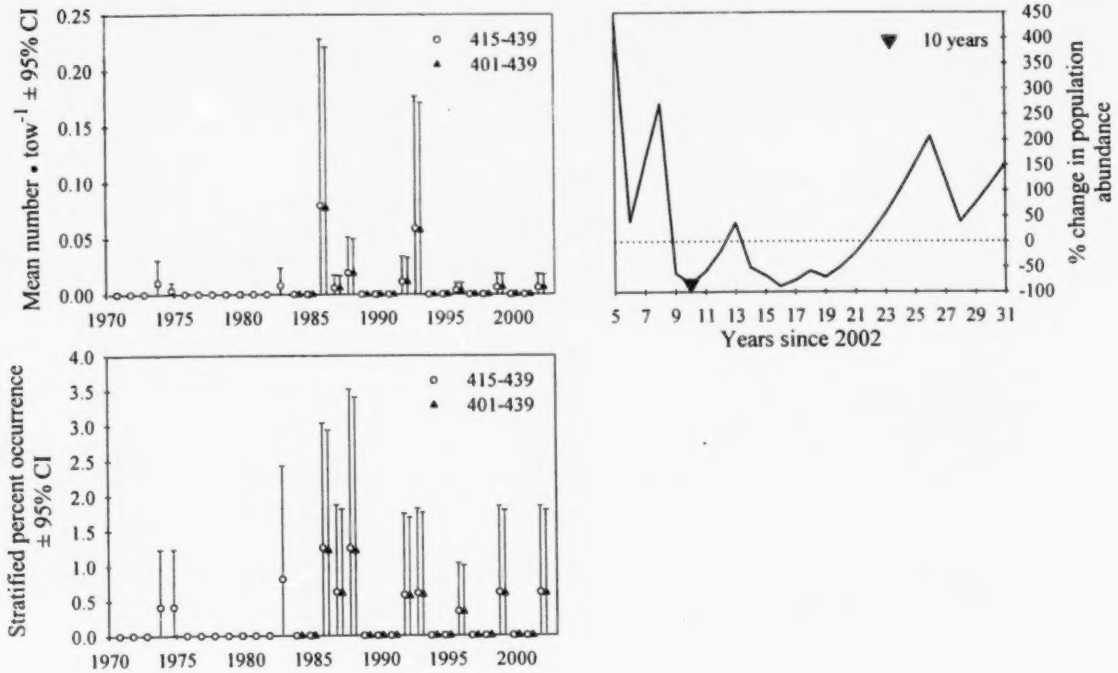

Figure 23a: Indicators of population status and distribution for northern wolffish, *Anarhichas denticulatus* (1971-2002).

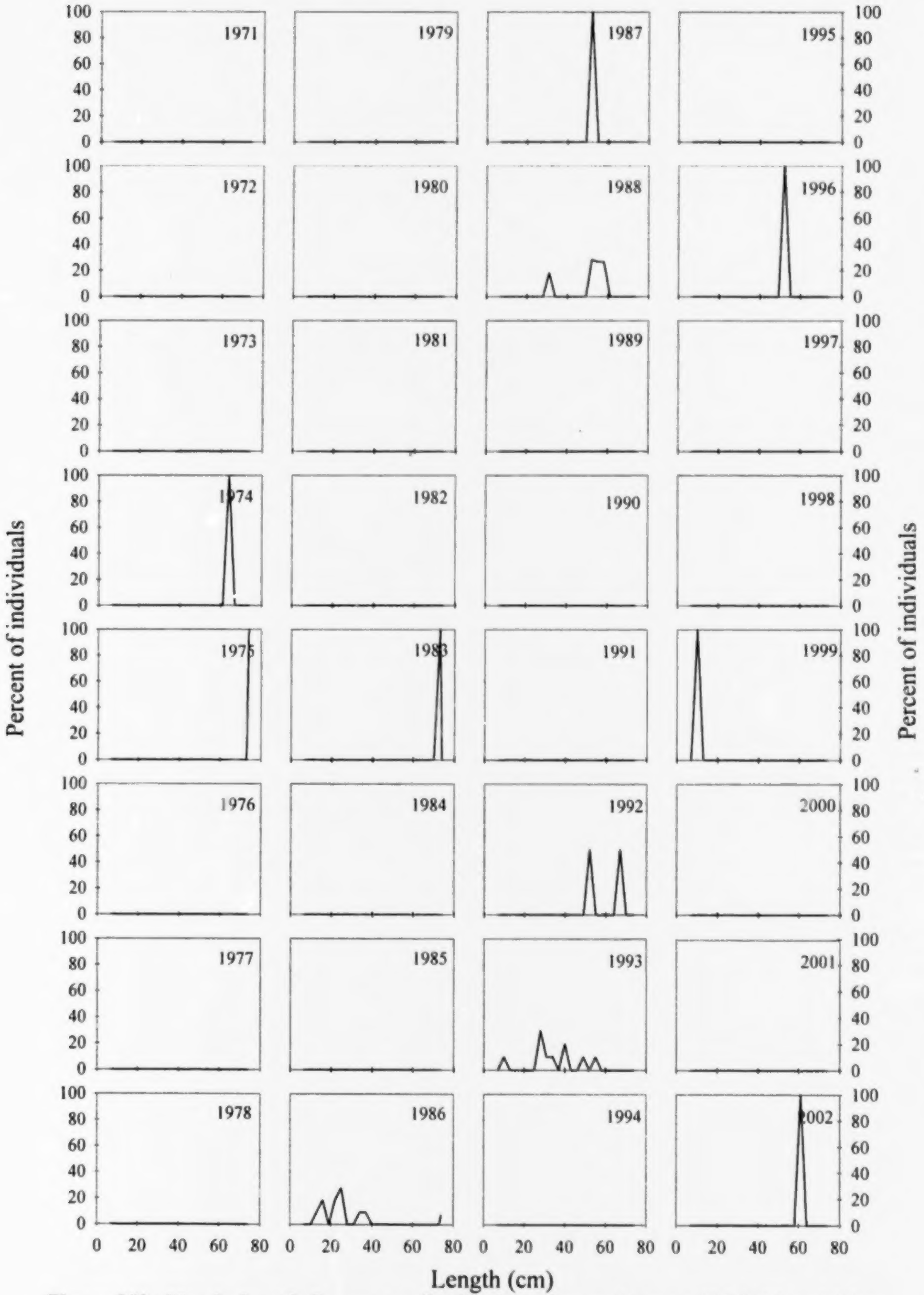

Figure 23b: Yearly length frequency distributions for northern wolffish (*Anarhichas denticulatus*).

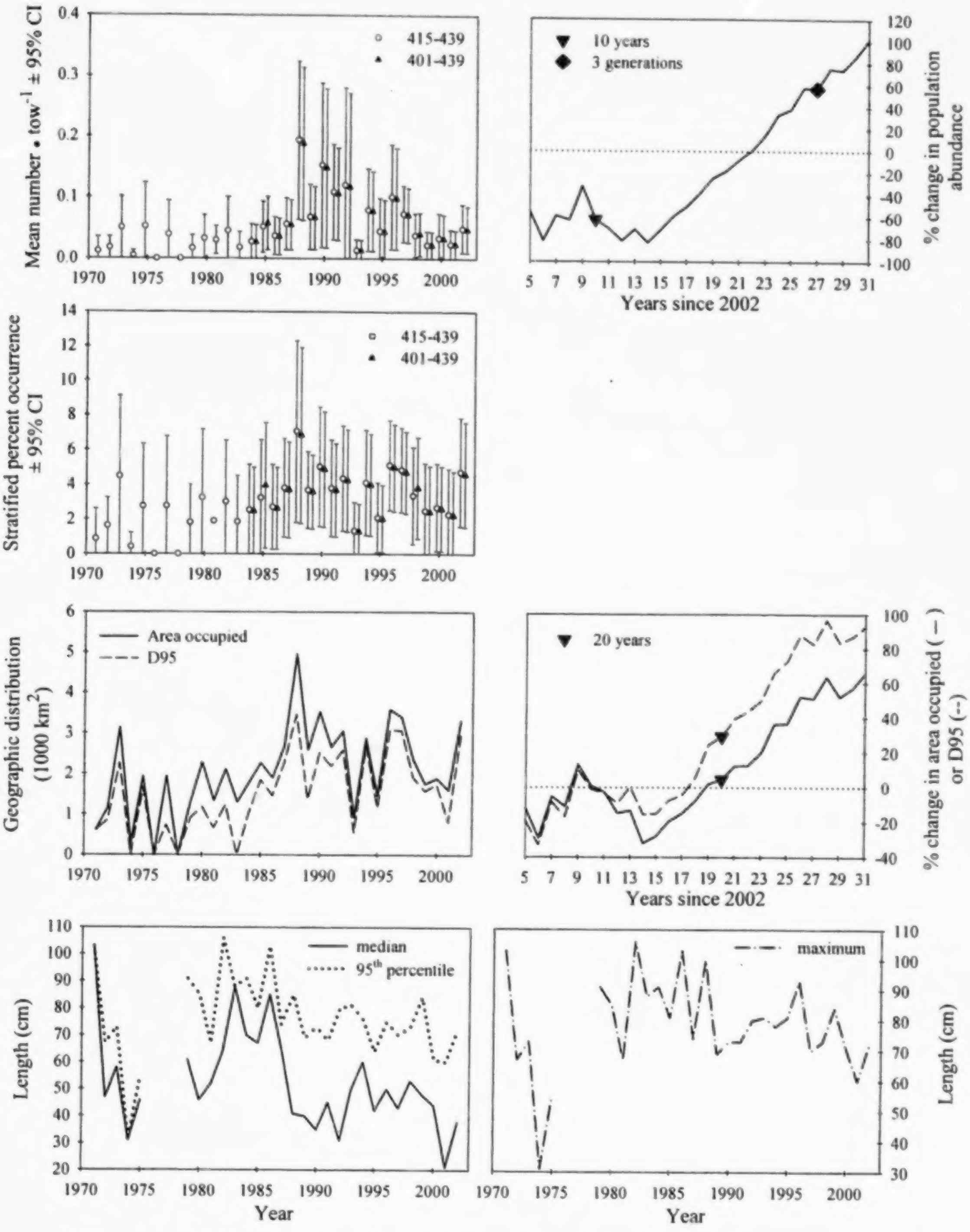

Figure 24a: Indicators of population status and distribution for striped Atlantic wolffish, *Anarhichas lupus* (1971-2002).

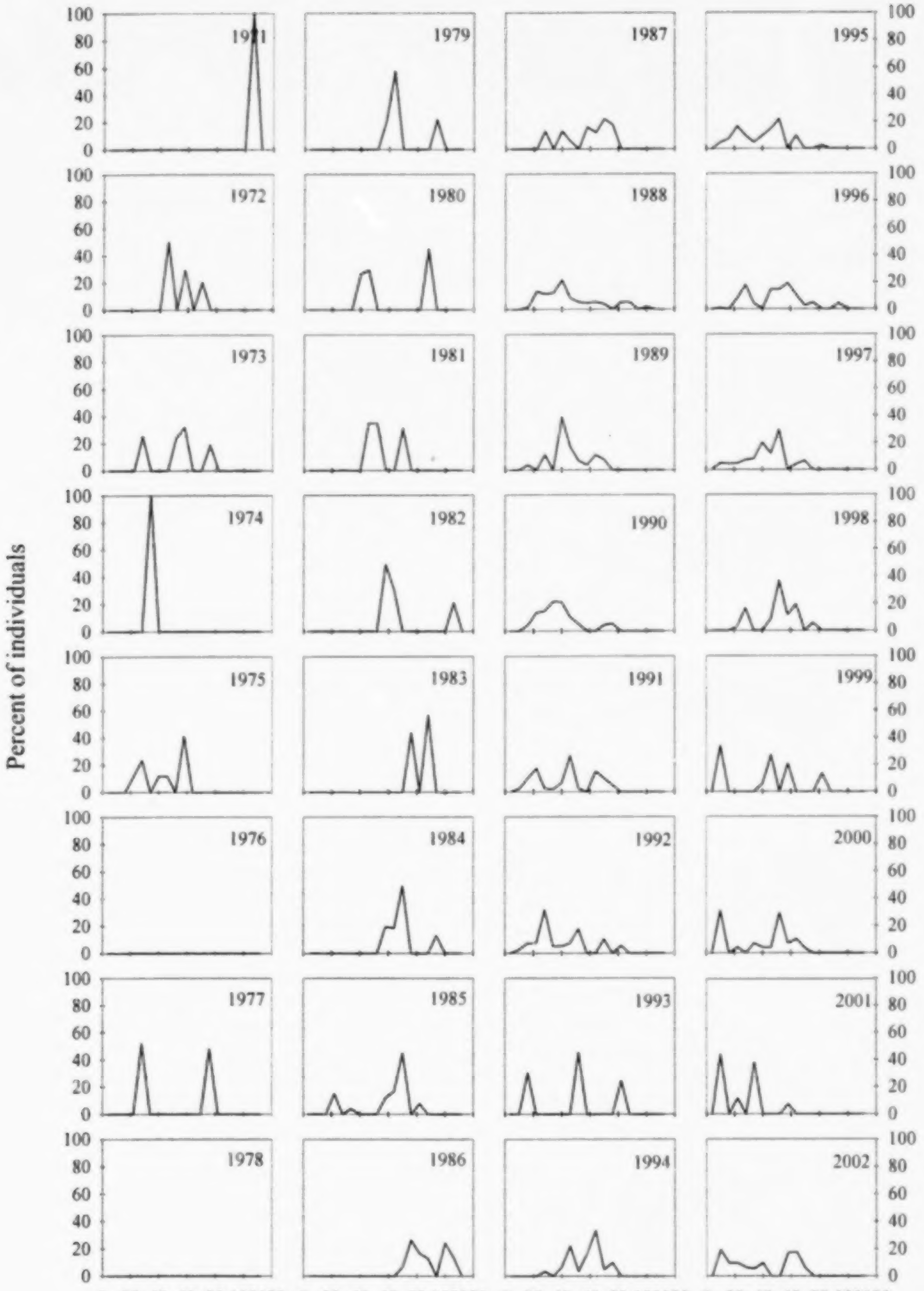

Figure 24b: Yearly length frequency distributions for striped Atlantic wolffish (*Anarhichas lupus*).

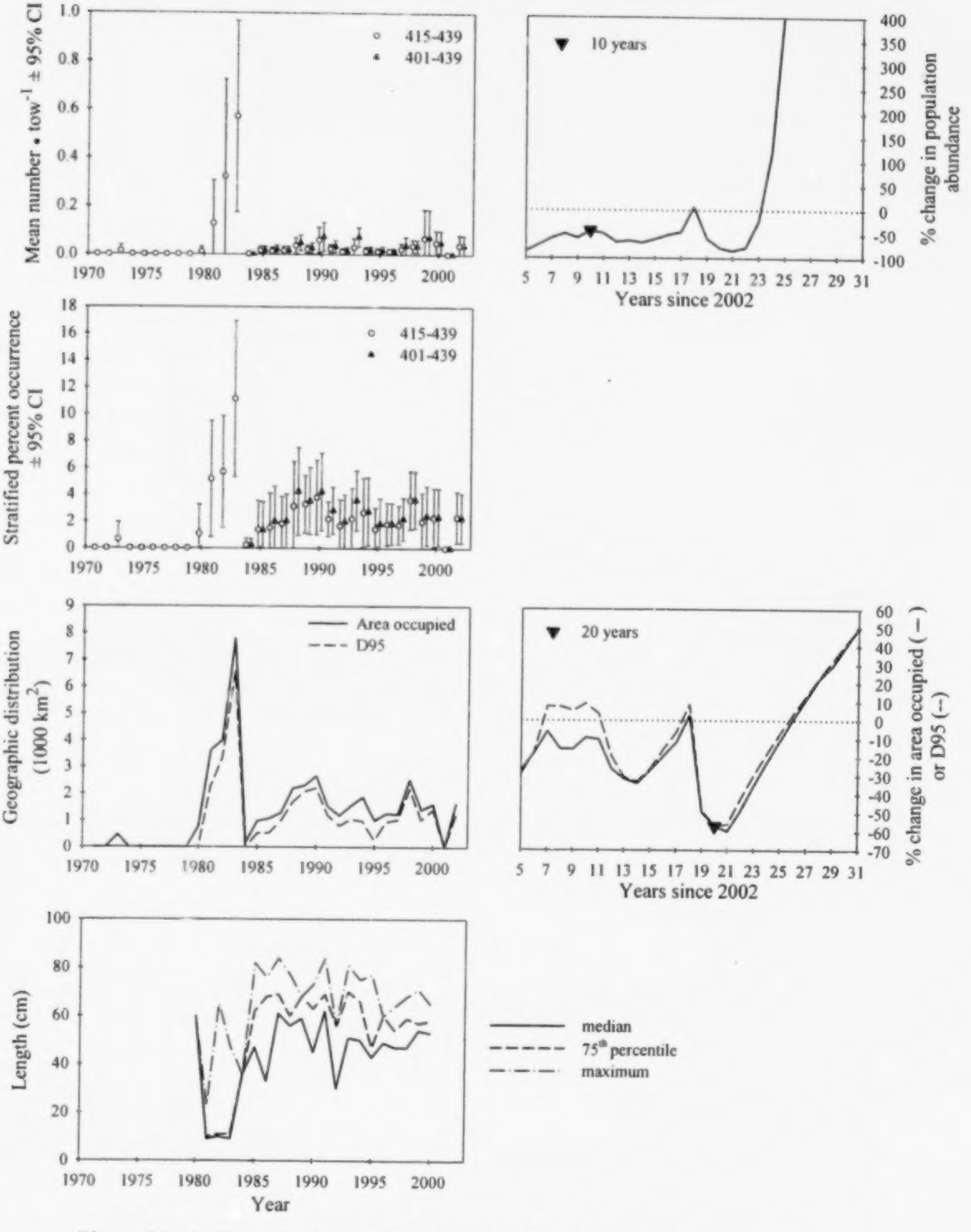

Figure 25a: Indicators of population status and distribution for wrymouth, *Cryptacanthodes maculatus* (1971-2002).

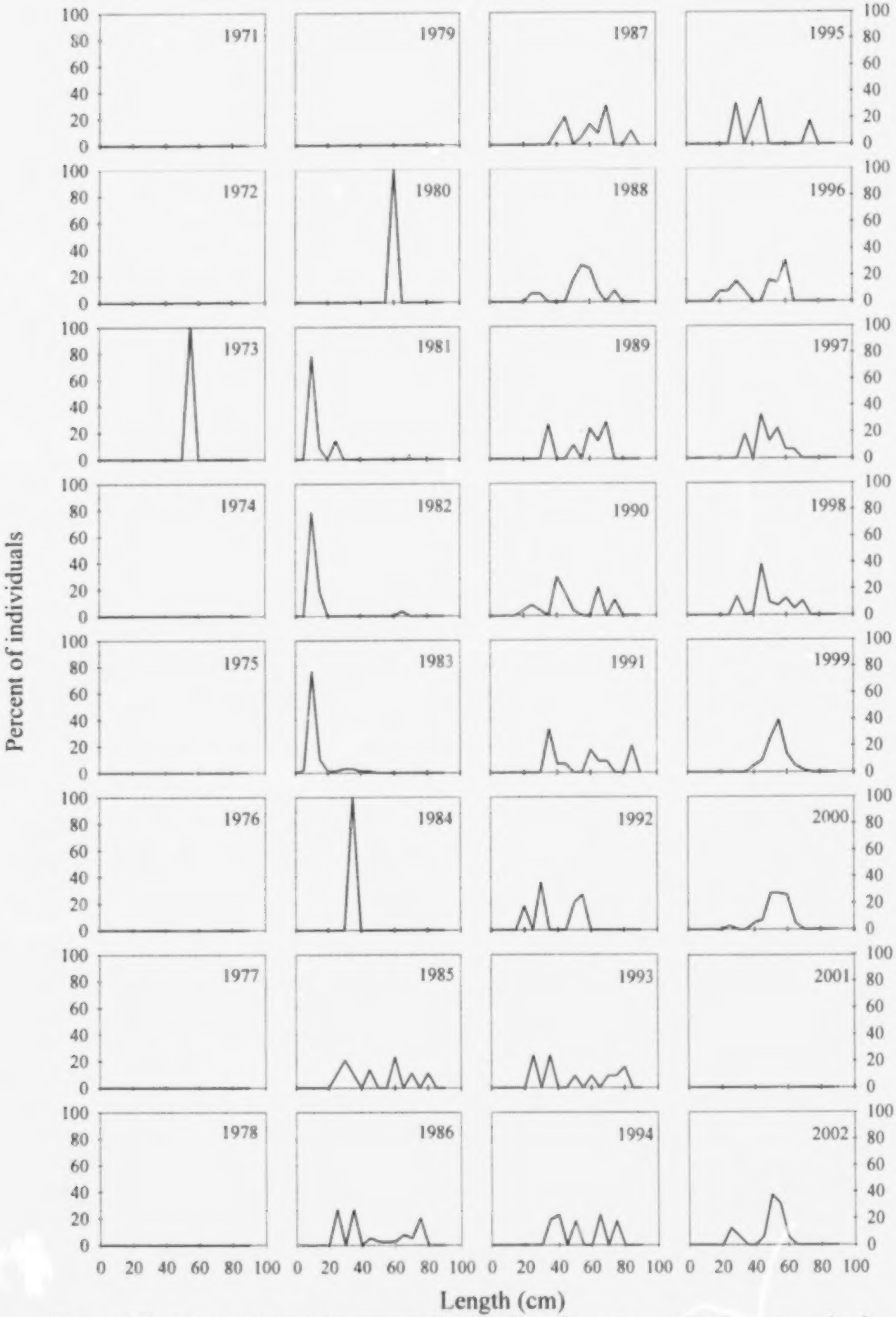

Figure 25b: Yearly length frequency distributions for wrymouth (*Cryptacanthodes maculatus*).

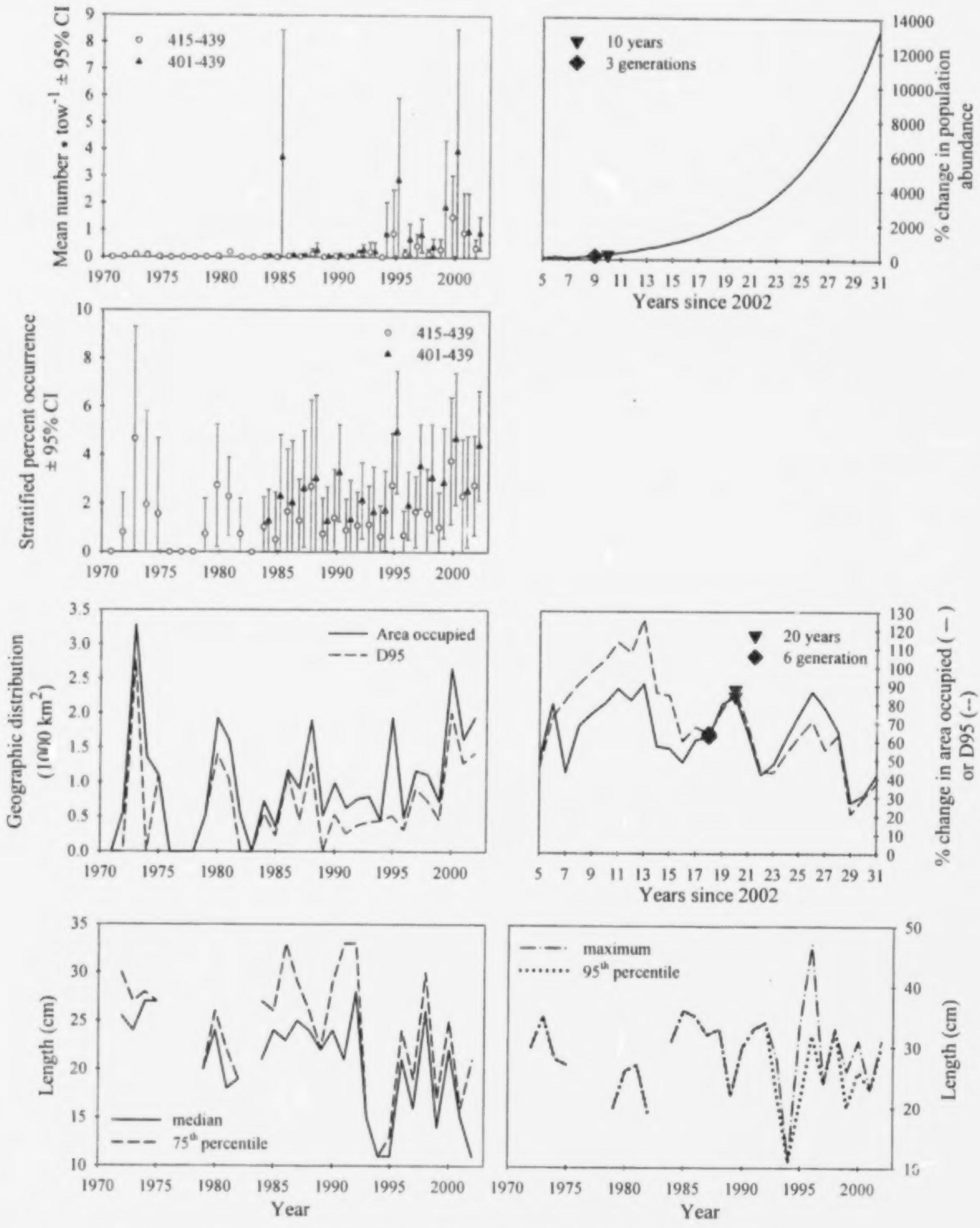

Figure 26a: Indicators of population status and distribution for cunner, *Tautogolabrus adspersus* (1971-2002).

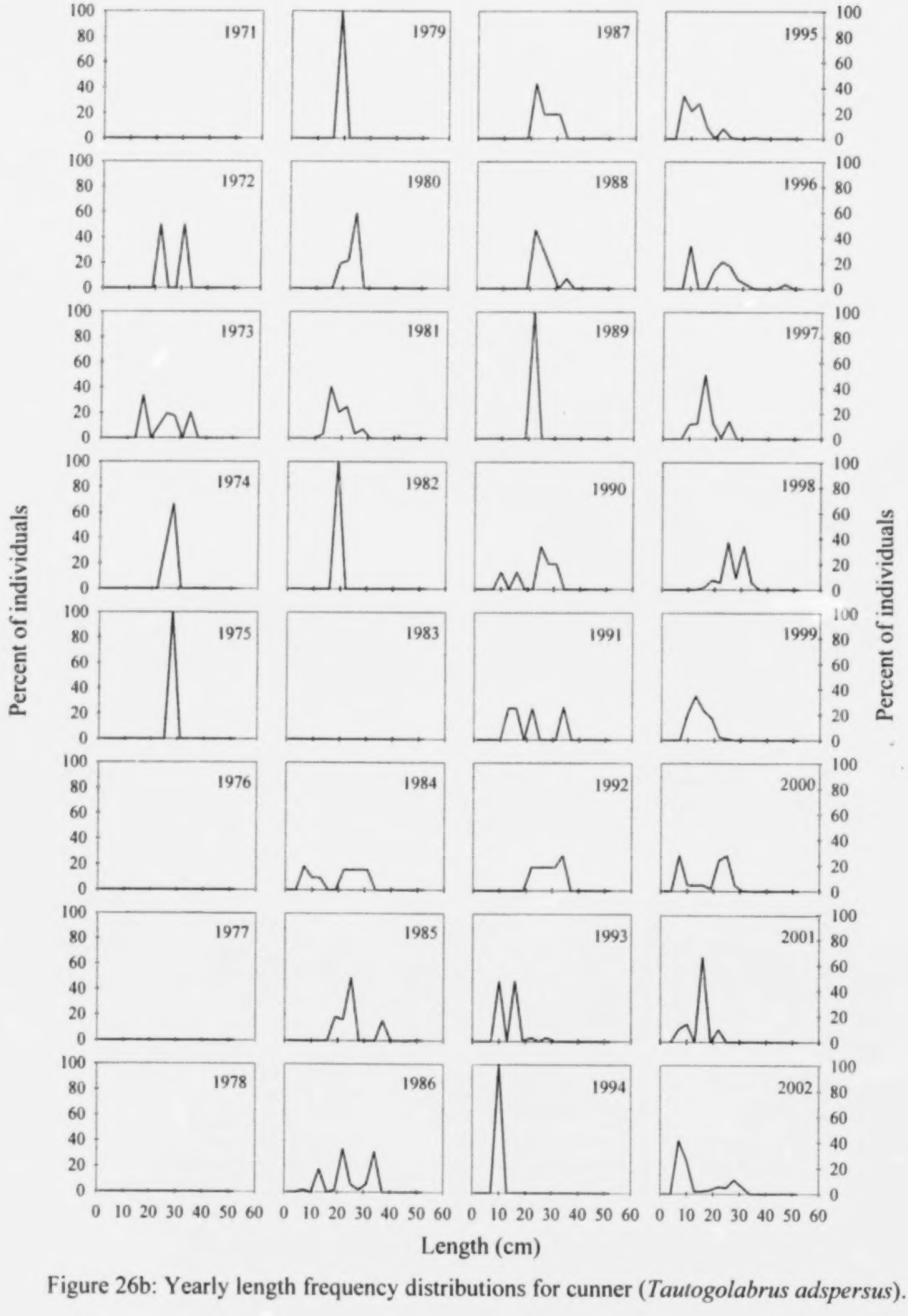

Figure 26b: Yearly length frequency distributions for cunner (*Tautogolabrus adspersus*).

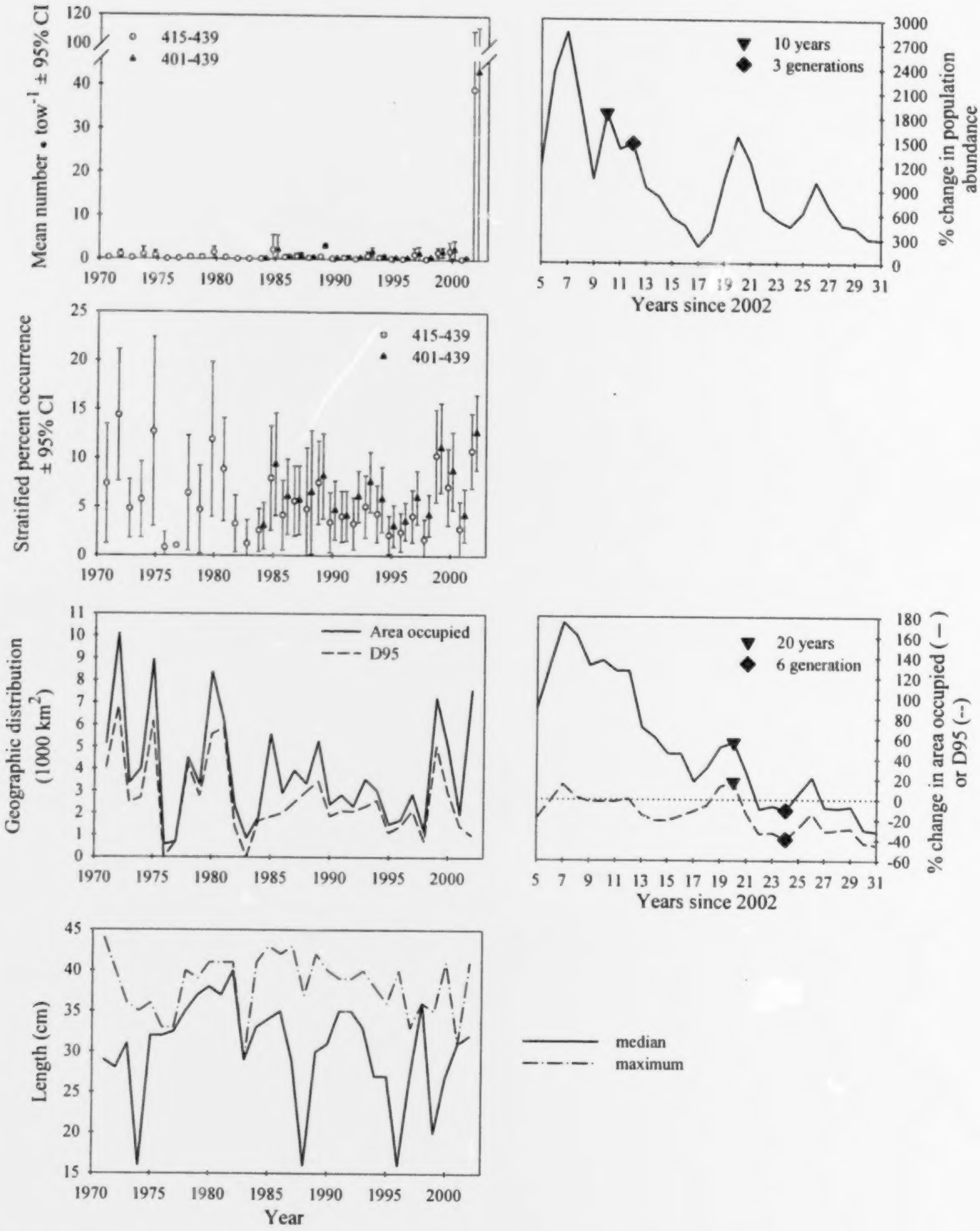

Figure 27a: Indicators of population status and distribution for Atlantic mackerel, *Scombrus scombrus* (1971-2002).

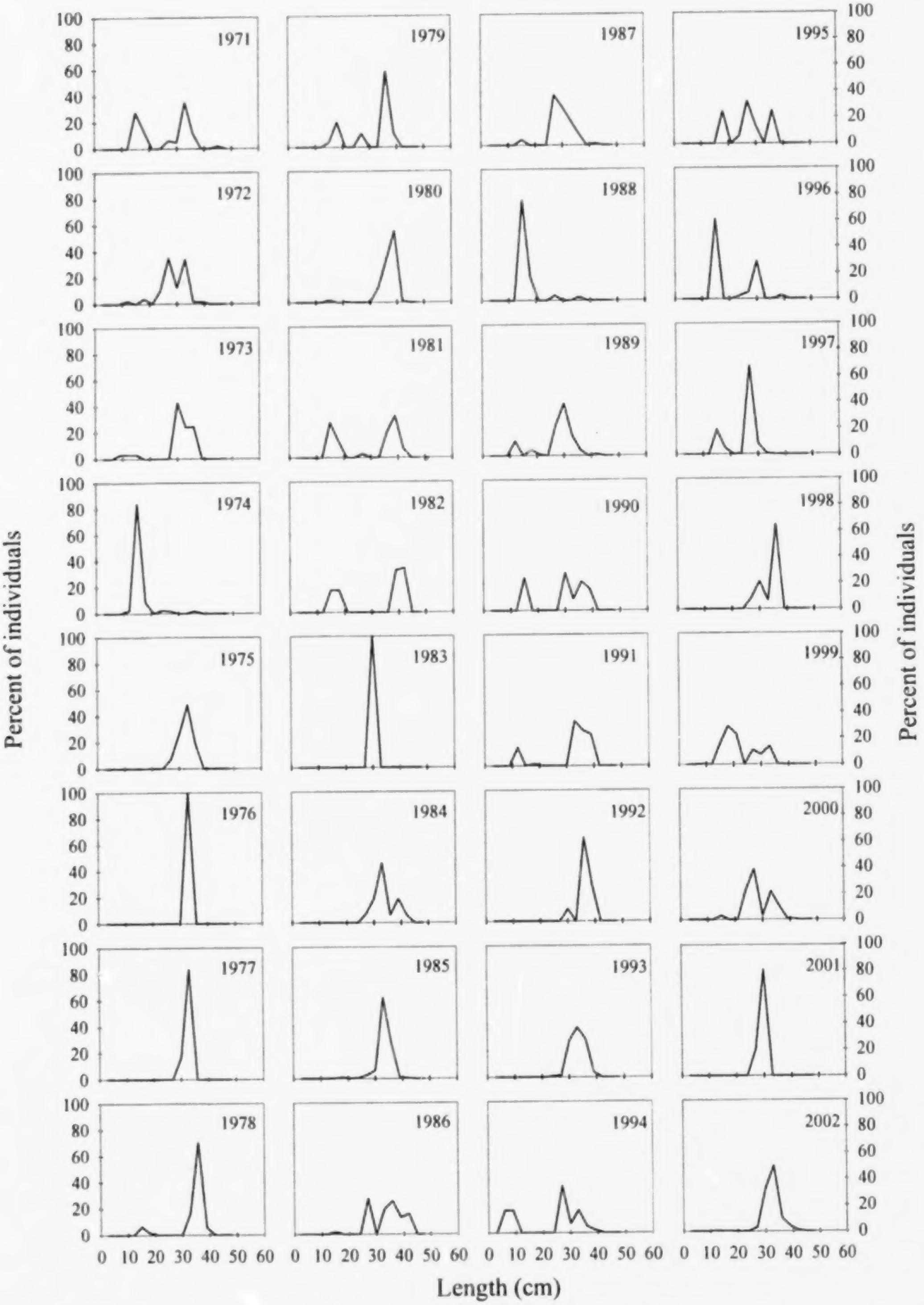

Figure 27b: Yearly length frequency distributions for Atlantic mackerel (*Scomber scombrus*).

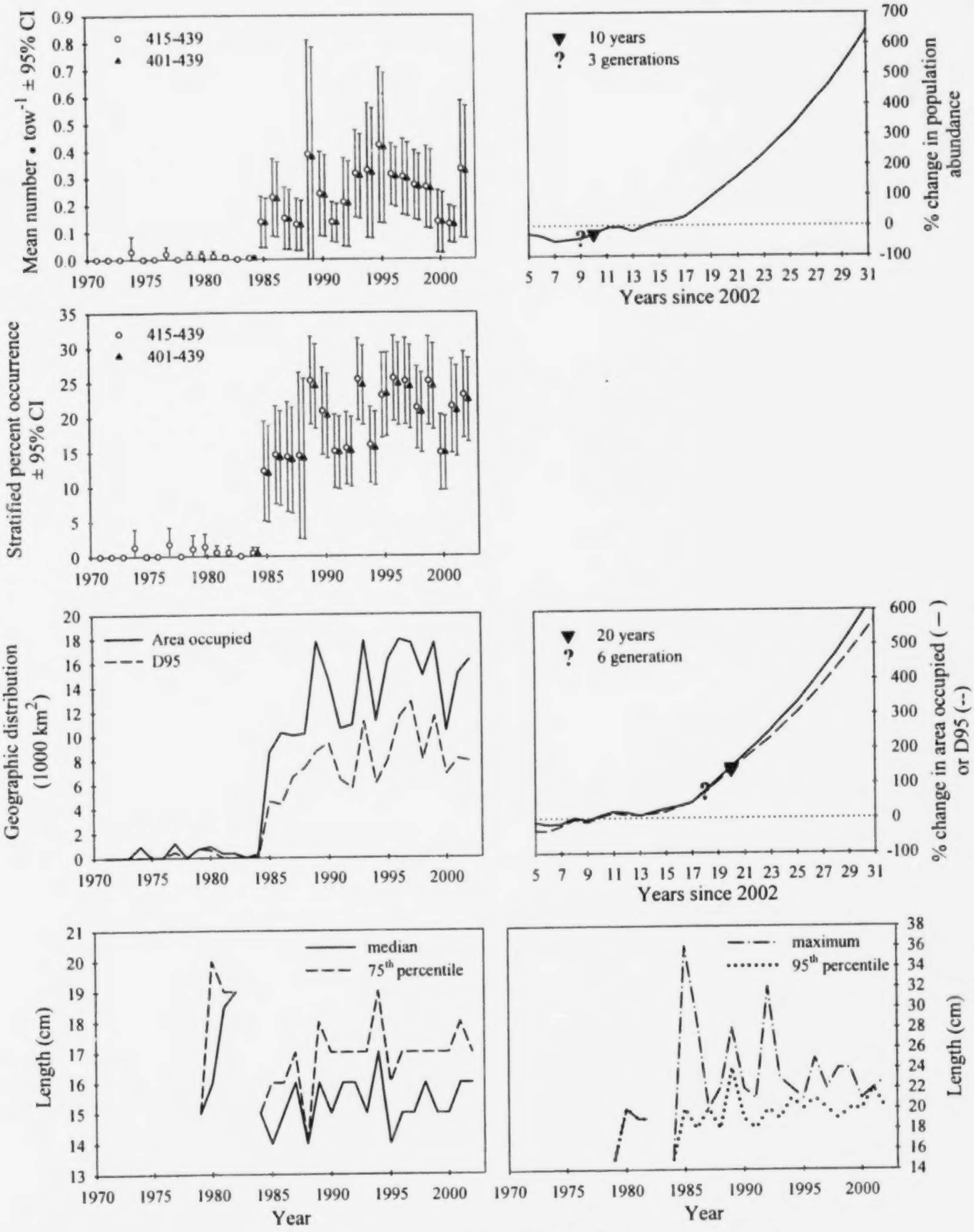

Figure 28a: Indicators of population status and distribution for fourline snakeblenny, *Eumesogrammus praecisus* (1971-2002).

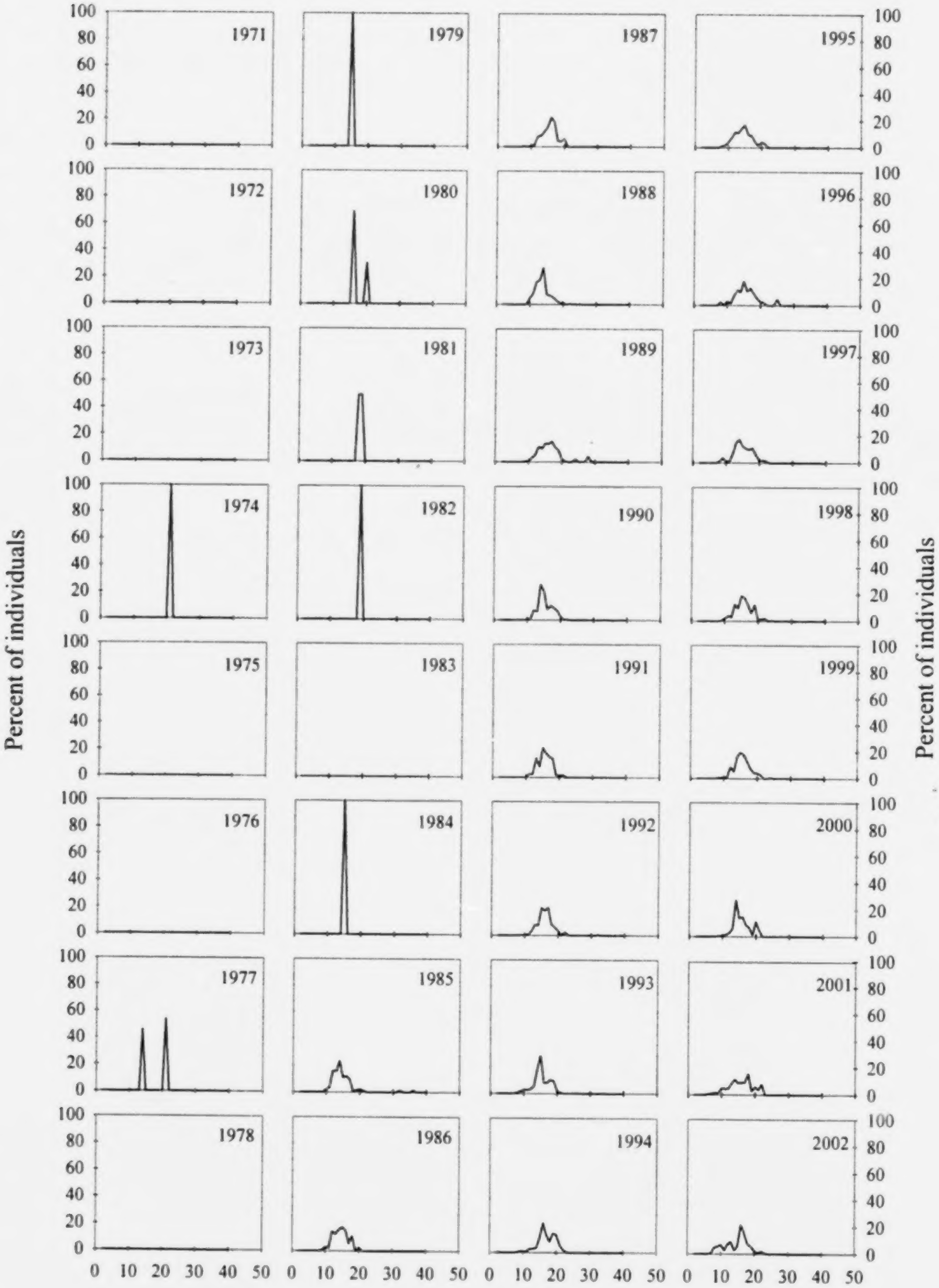

Figure 28b: Yearly length frequency distributions for fourline snakeblenny (*Eumesogrammus praecisus*).

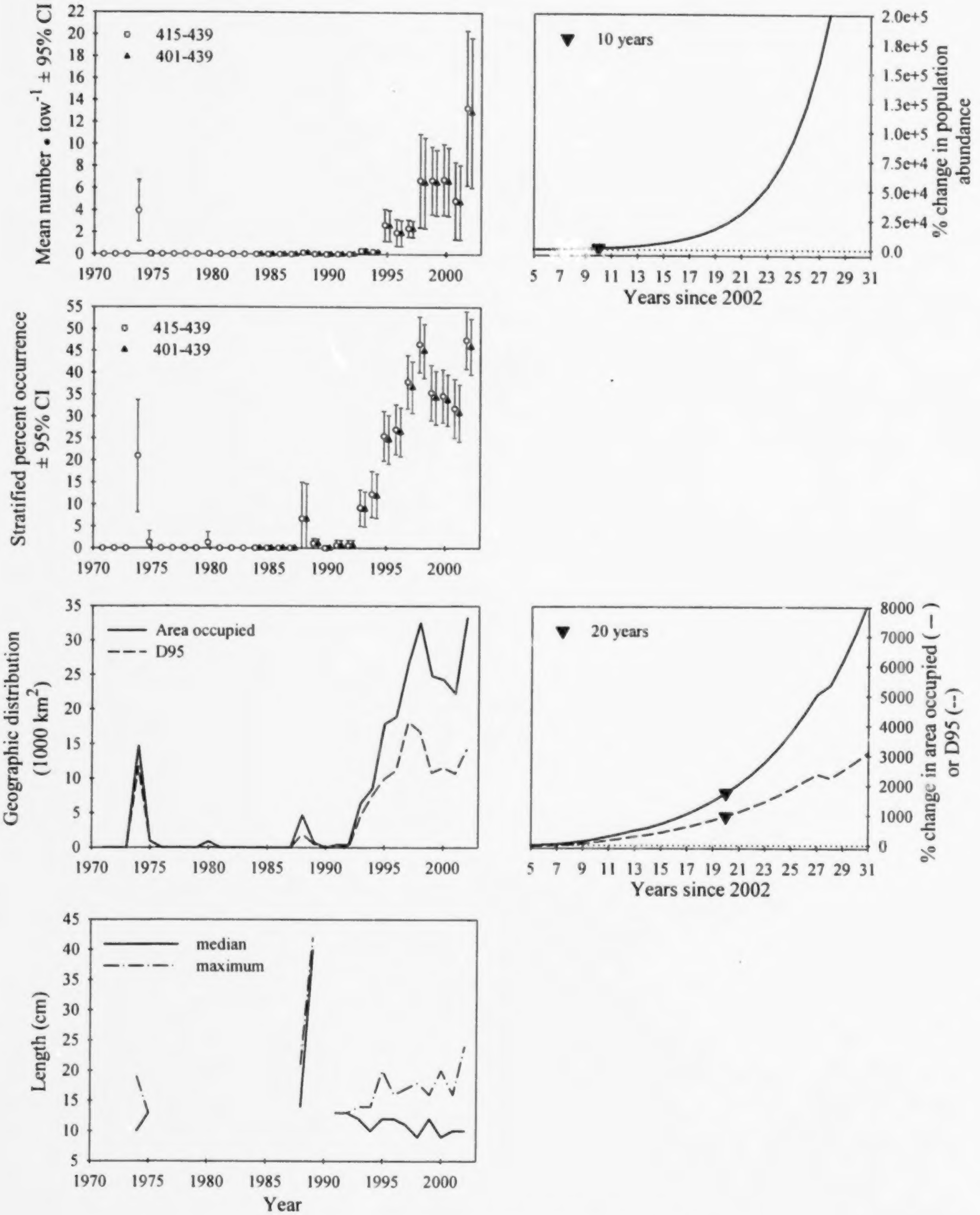

Figure 29a: Indicators of population status and distribution for daubed shanny, *Leptoclinus maculatus* (1971-2002).

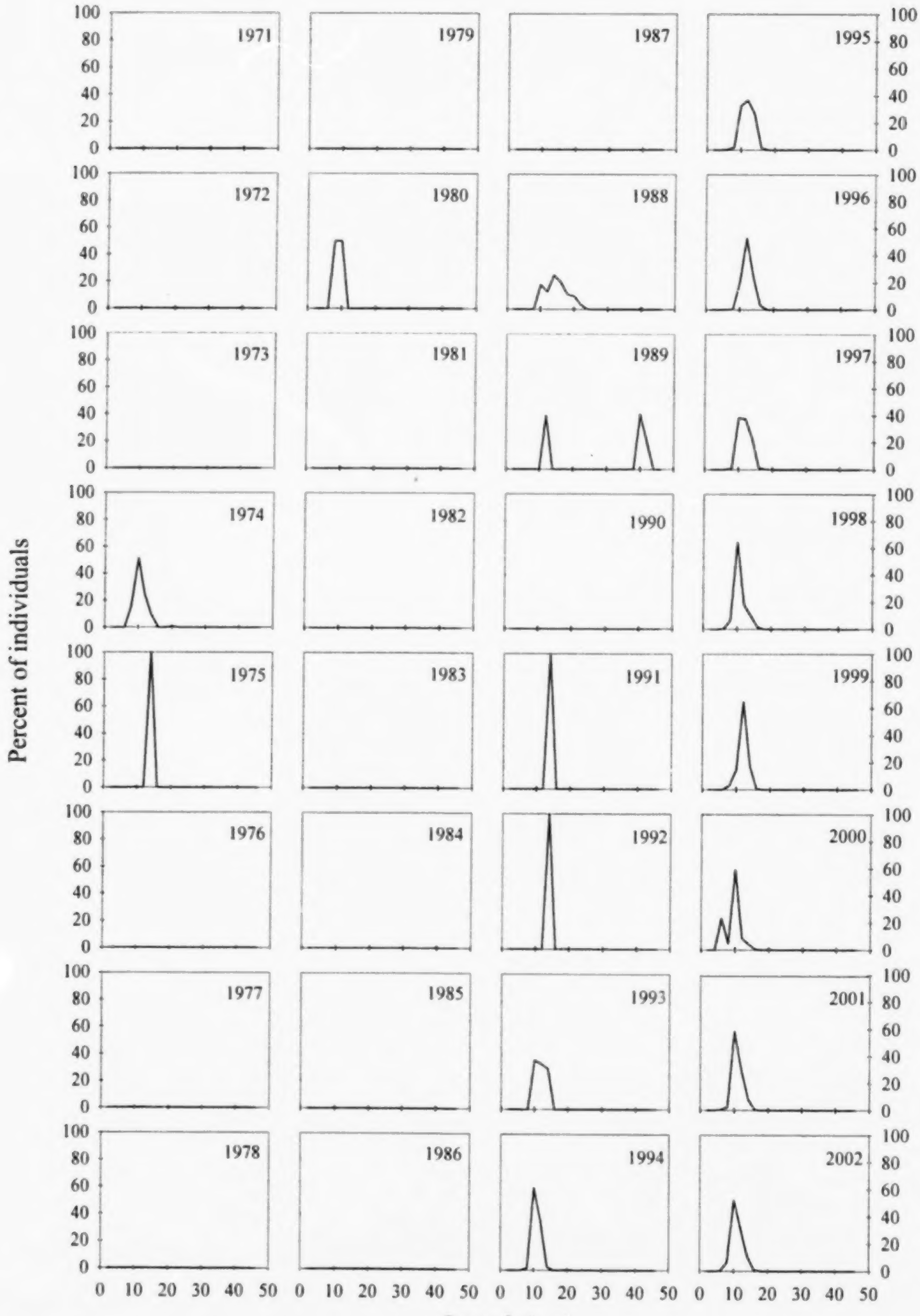

Figure 29b: Yearly length frequency distributions for daubed shanny (*Leptoclinus maculatus*).

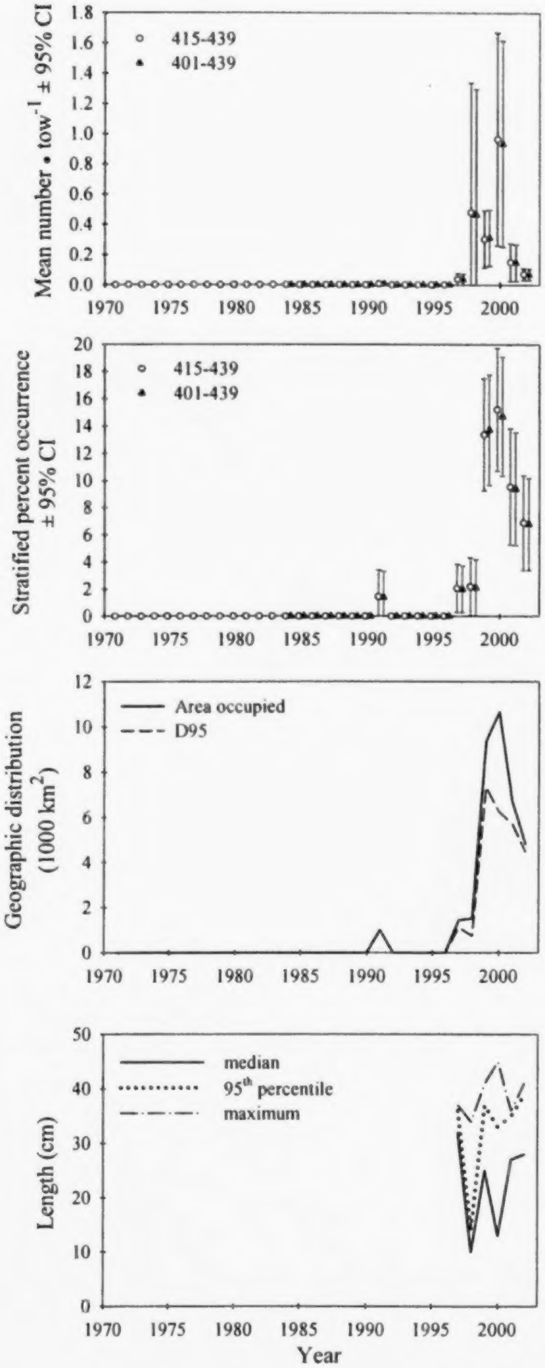

Figure 30a: Indicators of population status and distribution for slender eelblenny, *Lumpenus fabricii* (1971-2002).

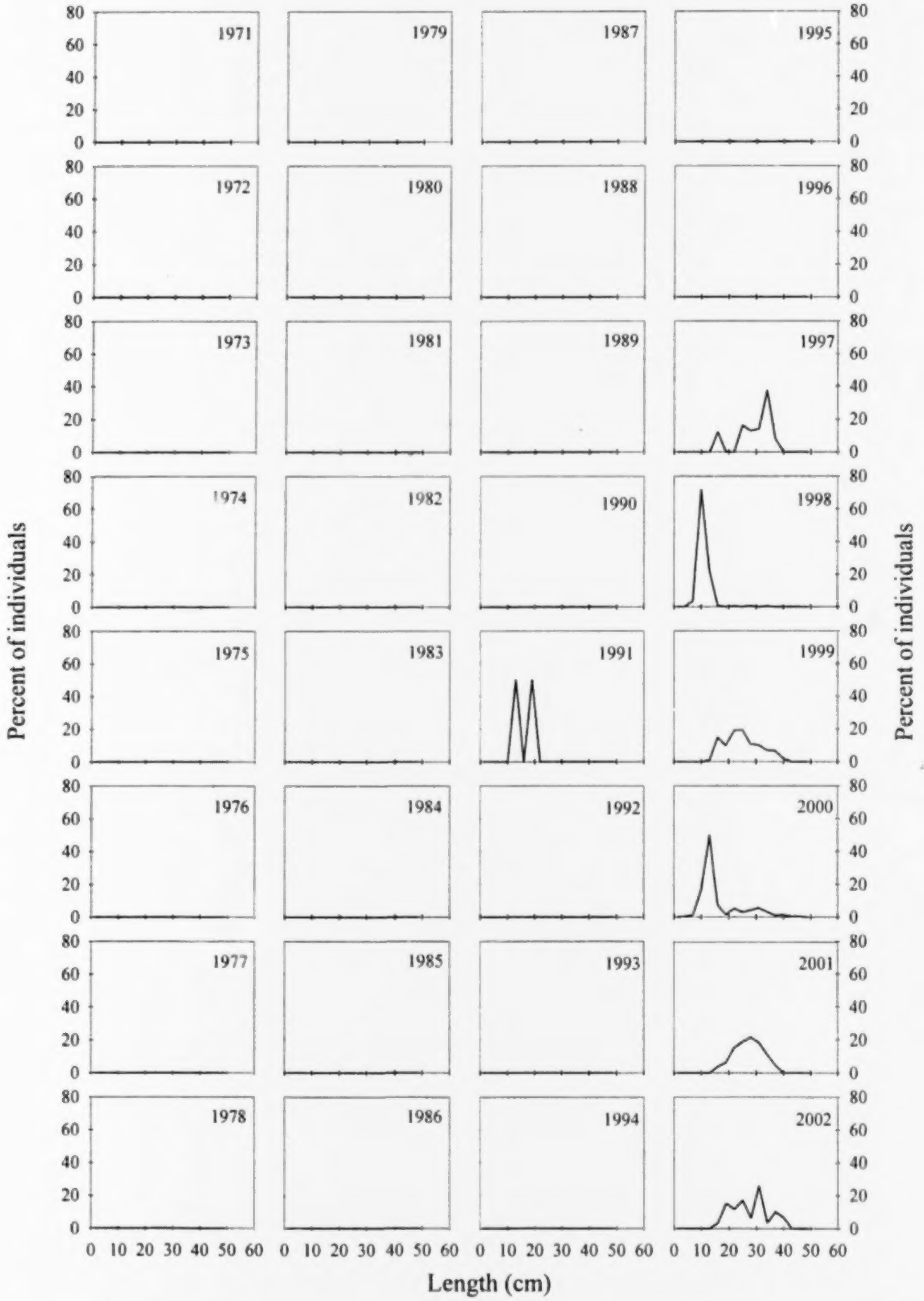

Figure 30b: Yearly length frequency distributions for slender eelblenny (*Lumpenus fabricii*).

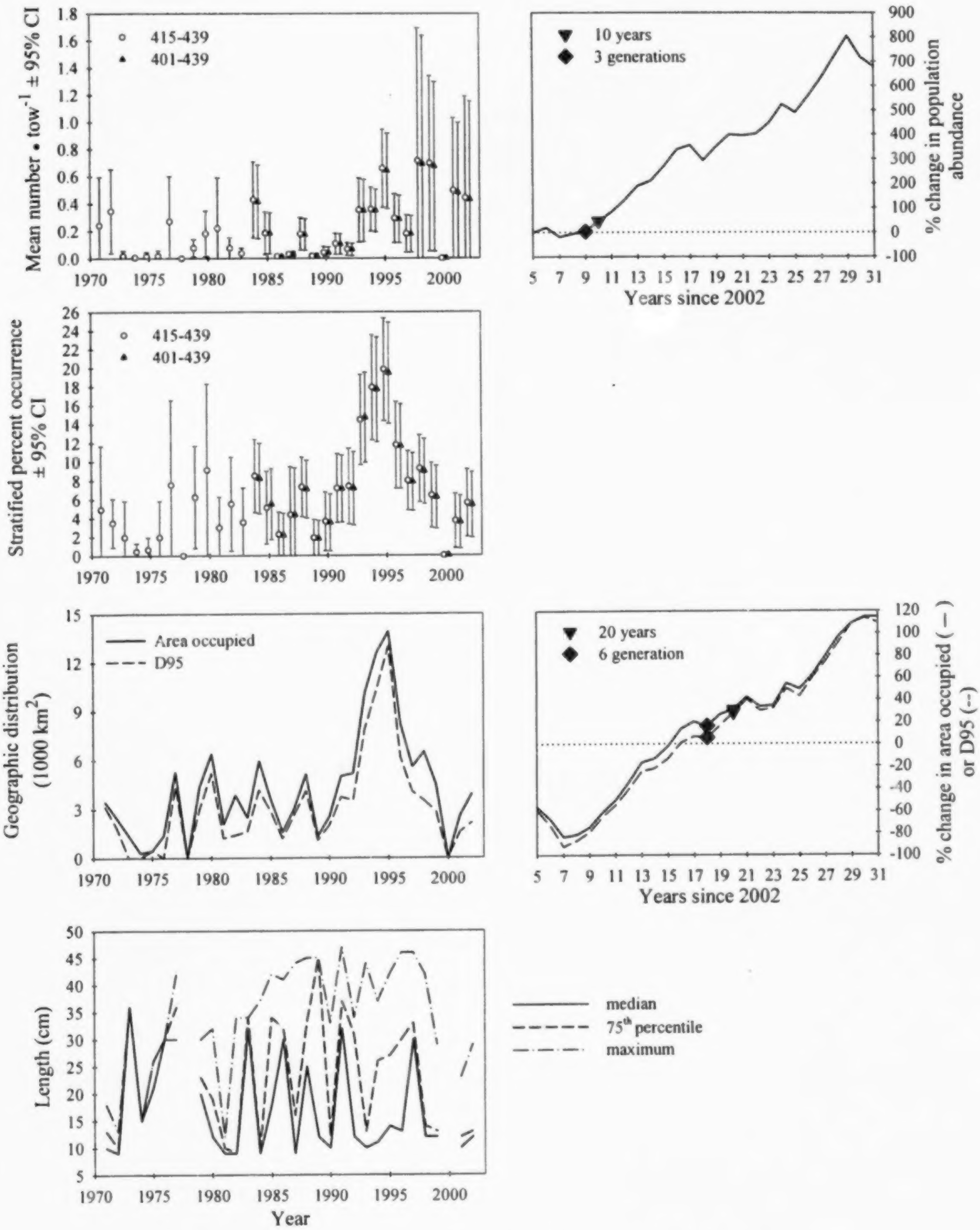

Figure 31a: Indicators of population status and distribution for snakeblenny, *Lumpenus lampretaeformis* (1971-2002).

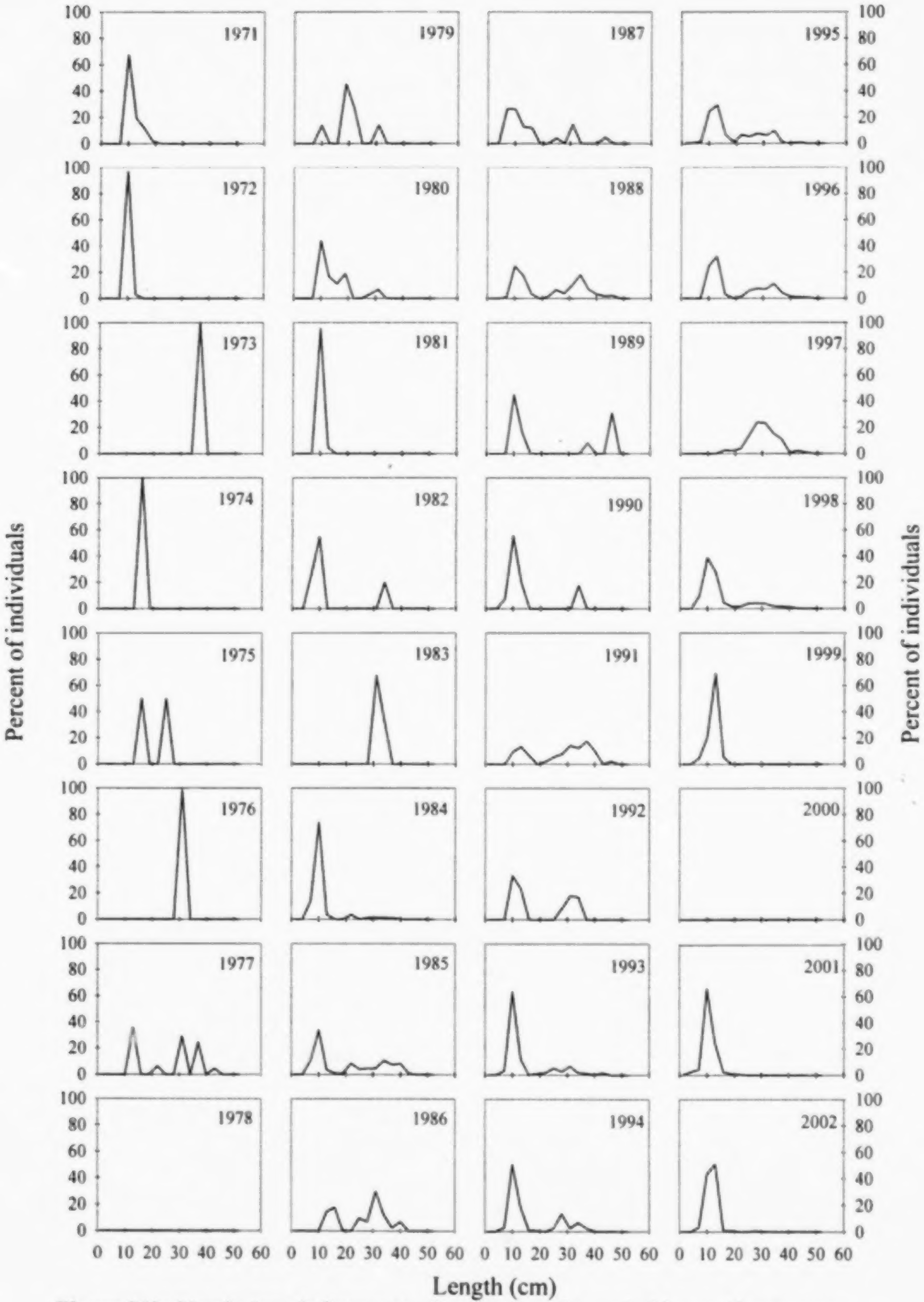

Figure 31b: Yearly length frequency distributions for snakeblenny (*Lumpenus lampretaeformis*).

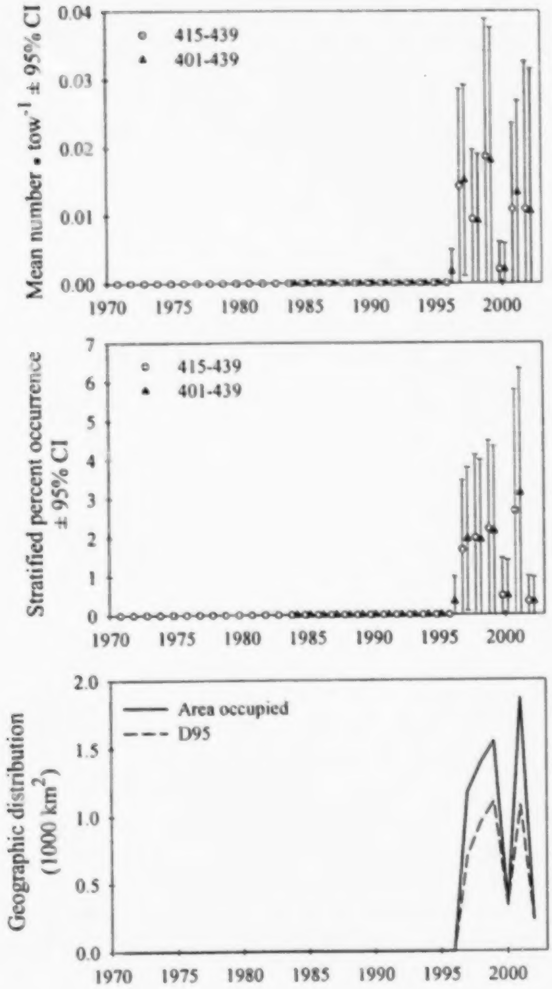

Figure 32: Indicators of population status and distribution for Arctic shanny, *Stichaeus punctatus* (1971-2002).

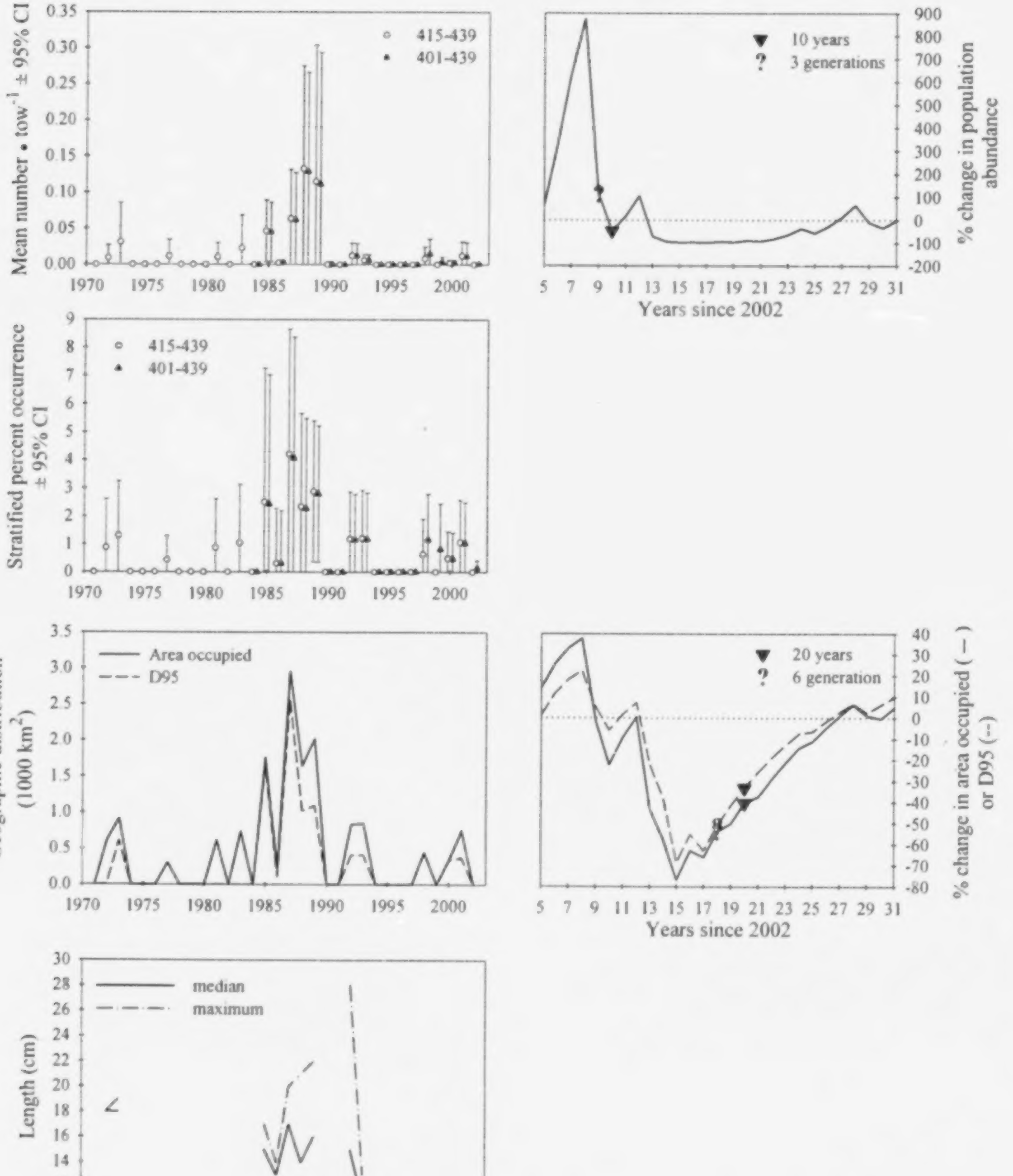

Figure 33a: Indicators of population status and distribution for radiated shanny, *Ulvaria subbifurcata* (1971-2002).

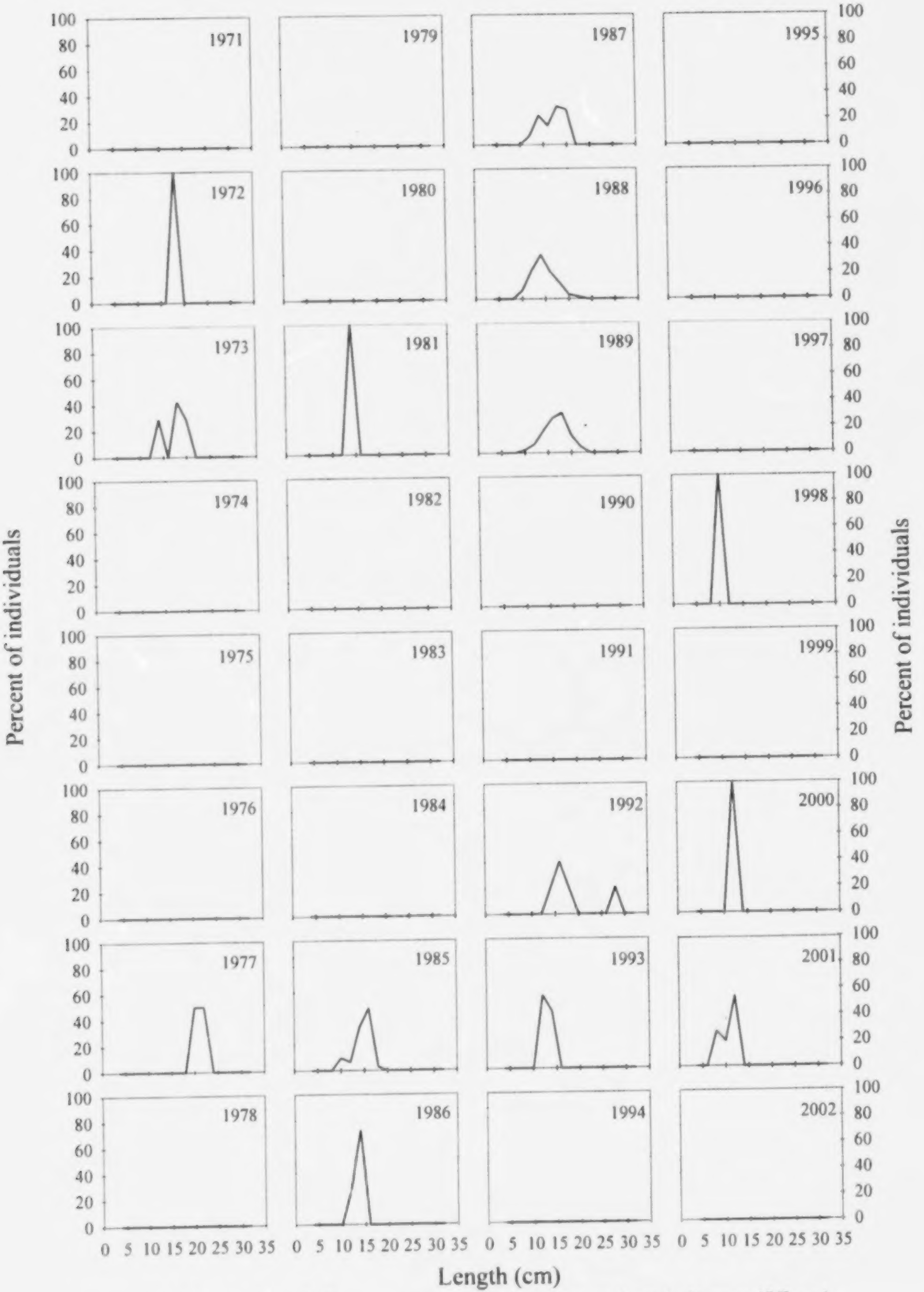

Figure 33b: Yearly length frequency distributions for radiated shanny (*Ulvaria subbifurcata*).

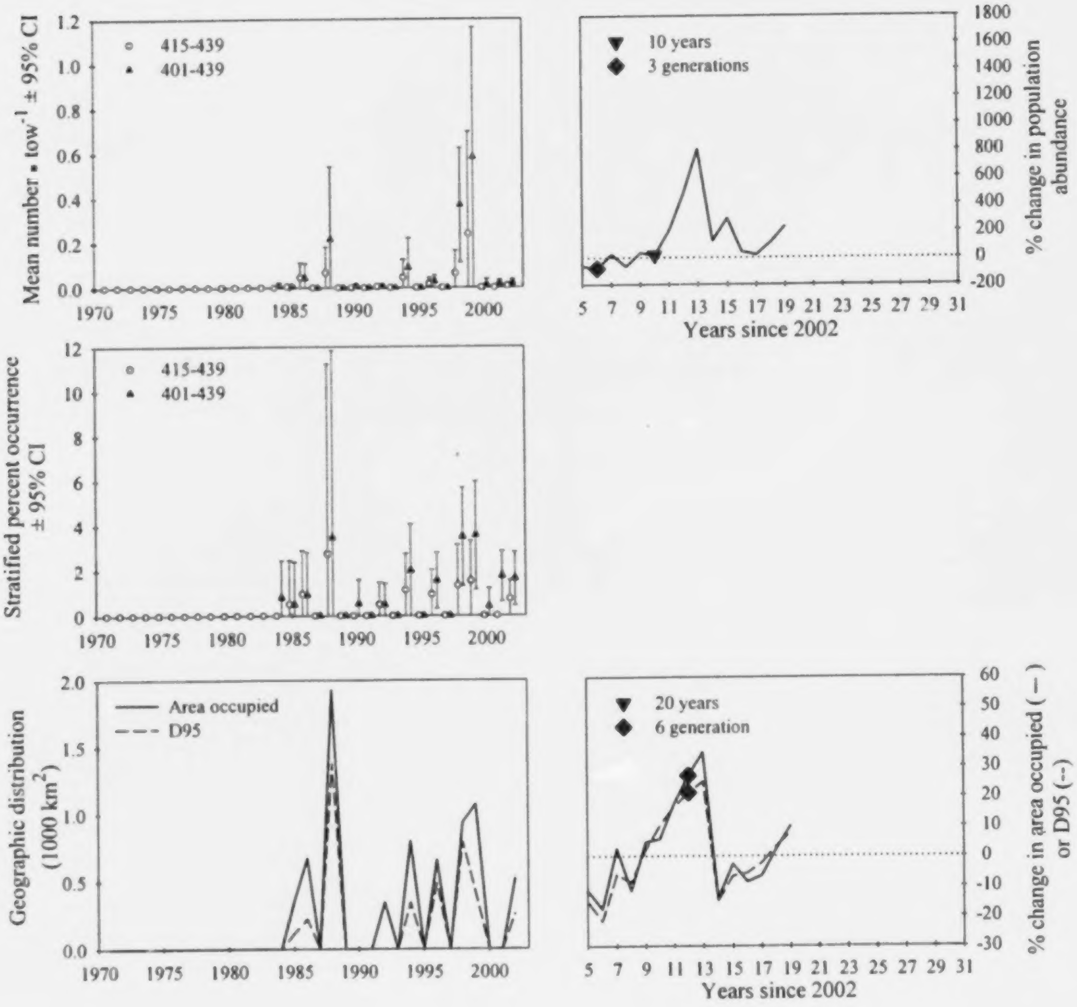

Figure 34a: Indicators of population status and distribution for butterfish, *Peprilus triacanthus* (1971-2002).

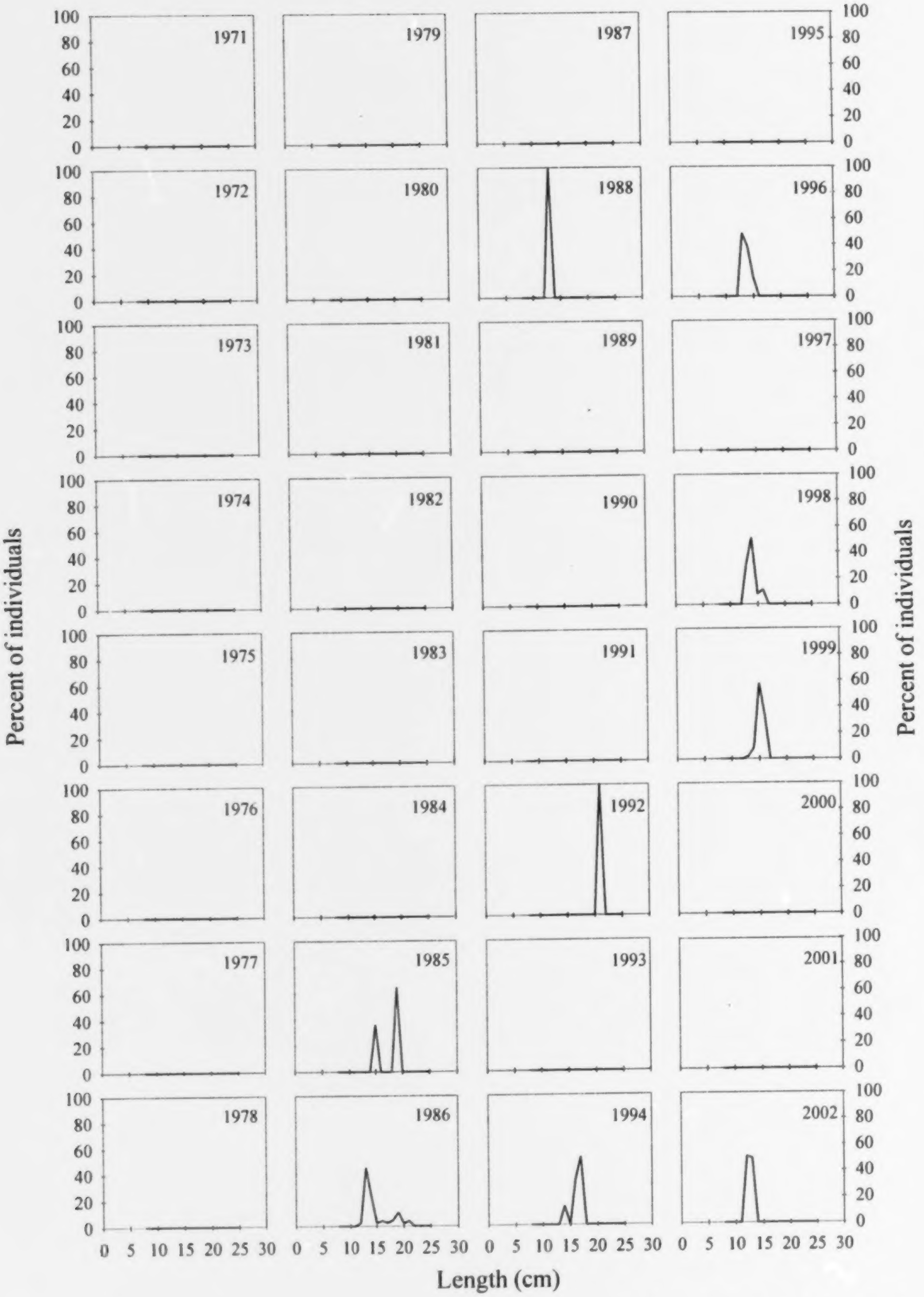

Figure 34b: Yearly length frequency distributions for butterfish (*Peprilus triacanthus*).

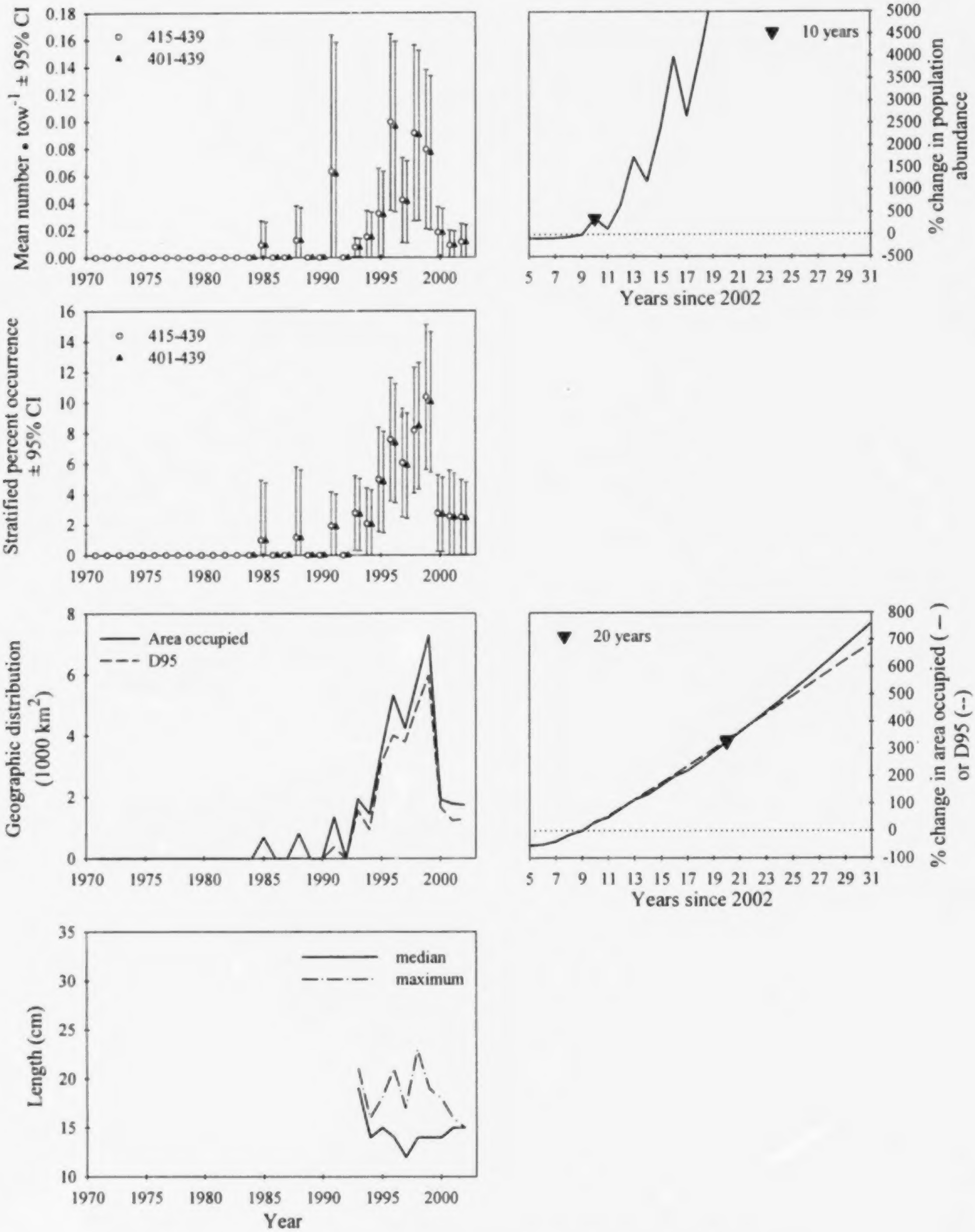

Figure 35a: Indicators of population status and distribution for fish doctor, *Gymnelus viridis* (1971-2002).

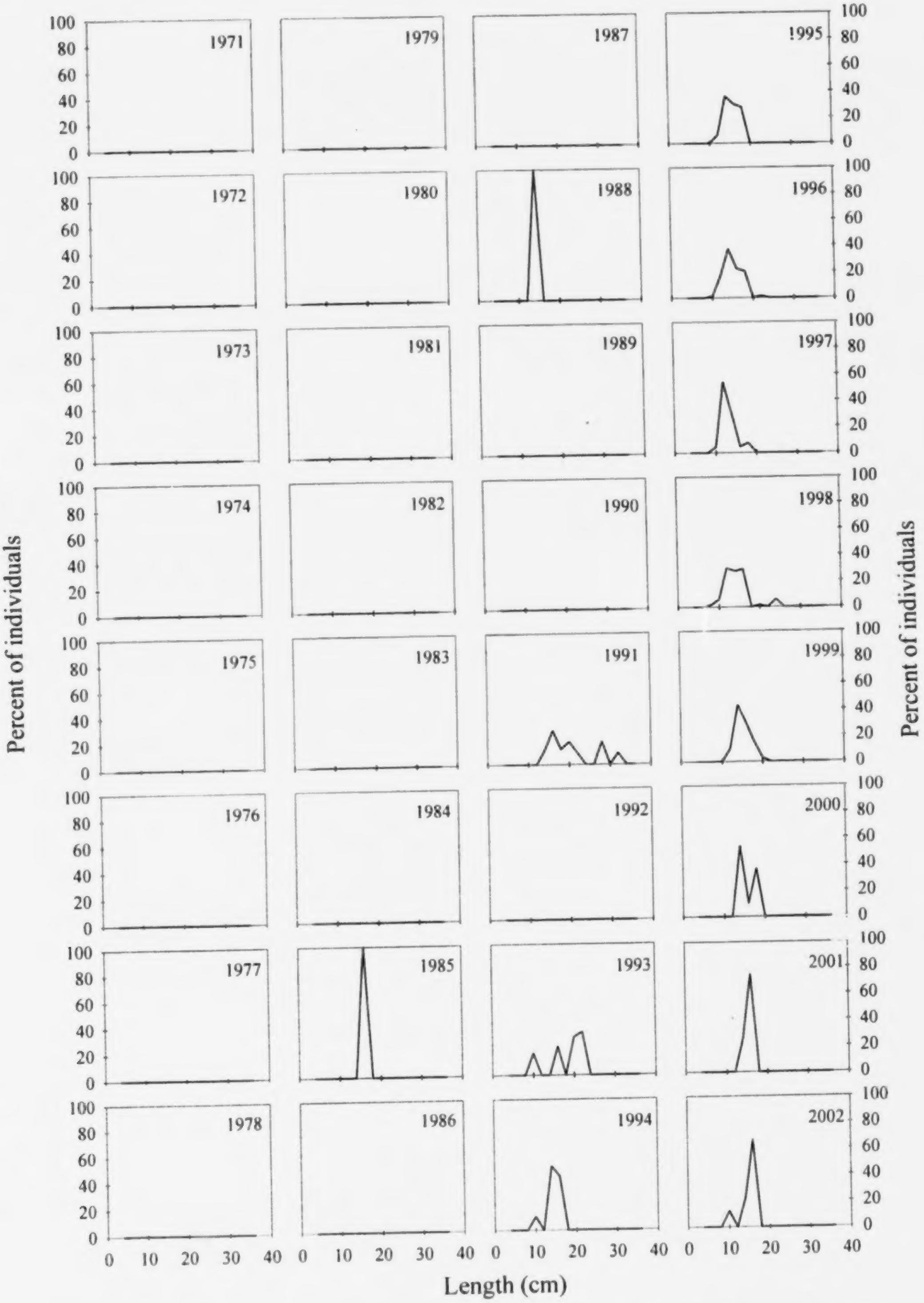

Figure 35b: Yearly length frequency distributions for fish doctor (*Gymnelis viridis*).

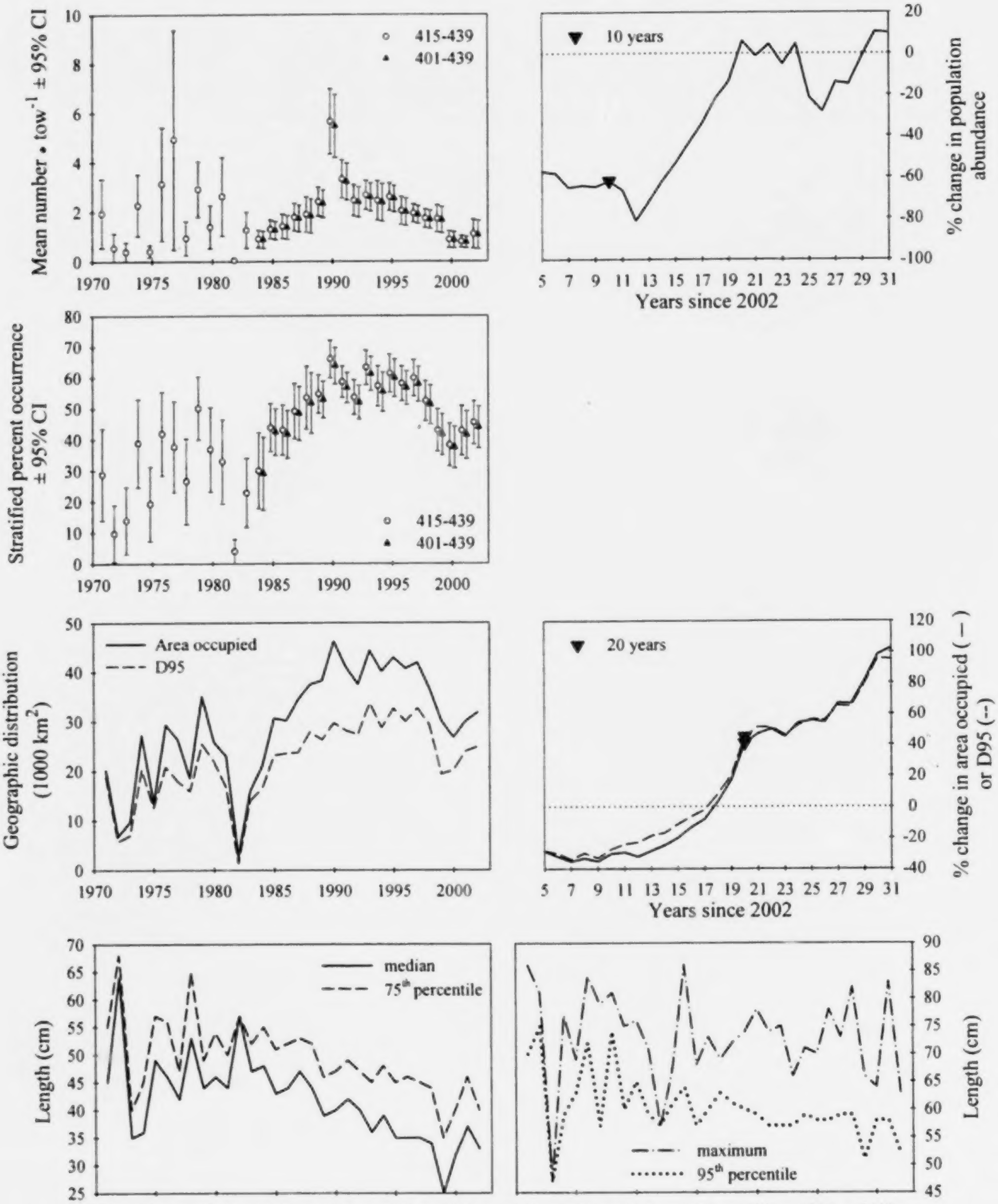

Figure 36a: Indicators of population status and distribution for eelpouts (unseparated), *Lycodes* spp. (1971-2002).

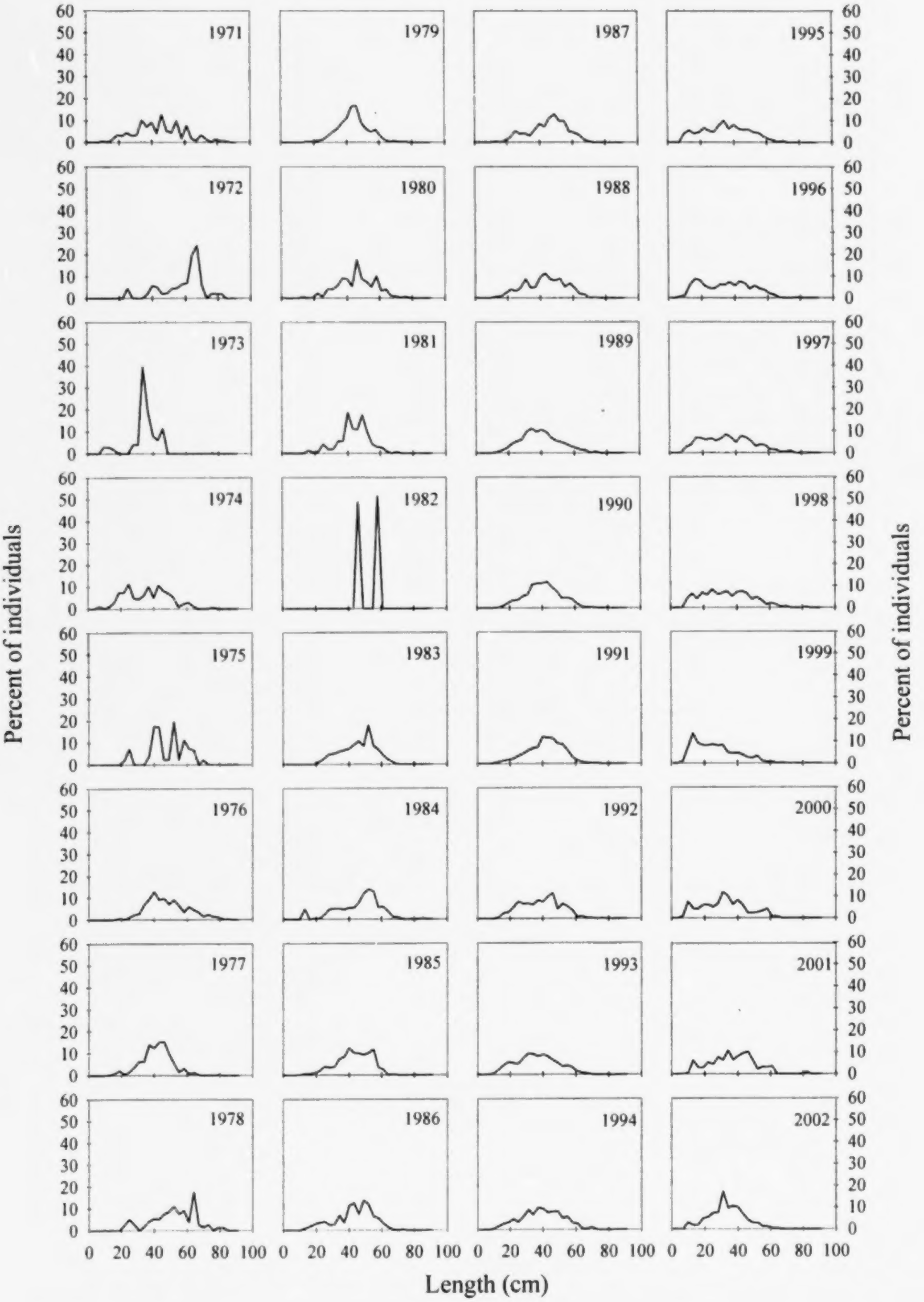

Figure 36b: Yearly length frequency distributions for unseparated eelpouts (*Lycodes* spp.).

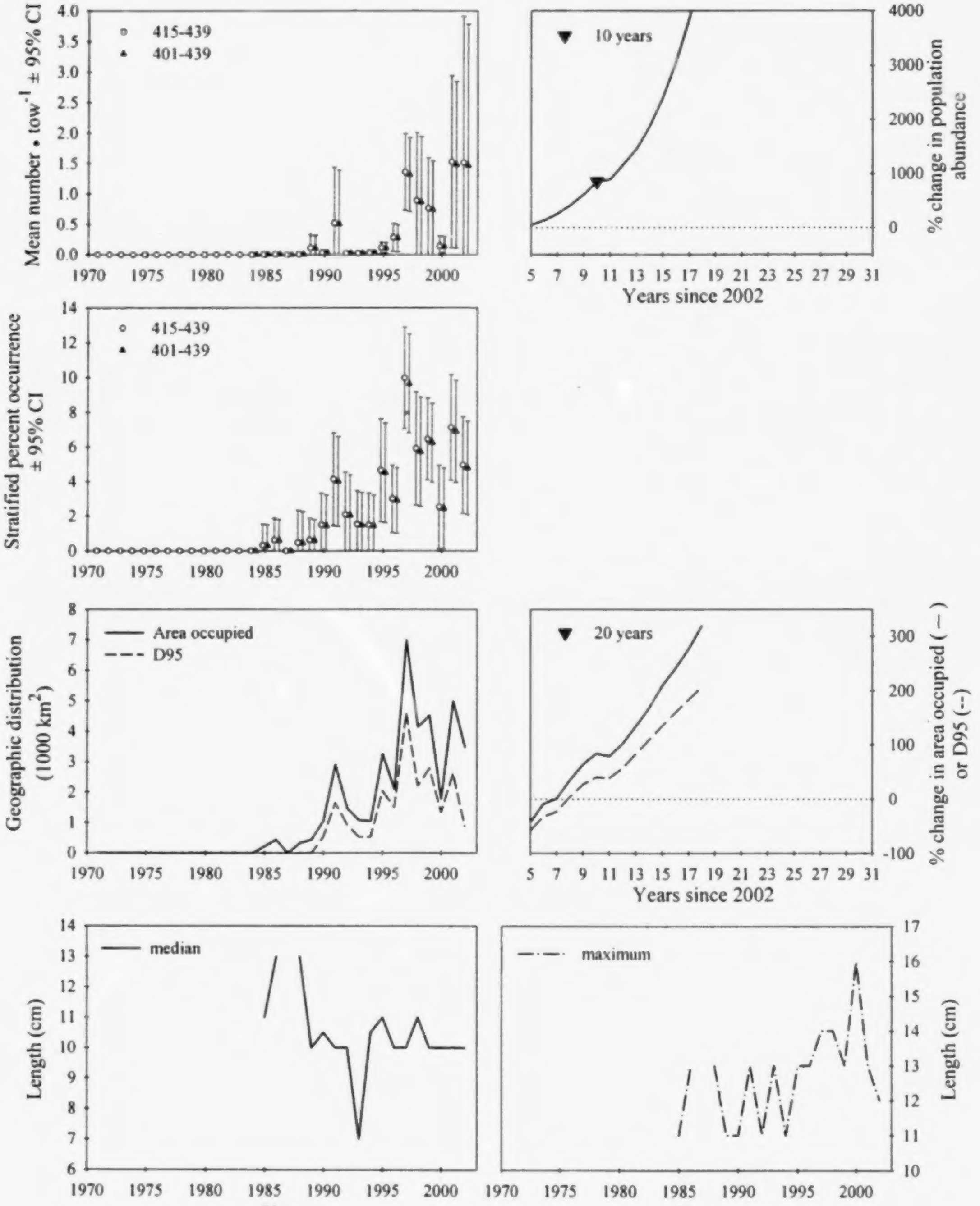

Figure 37a: Indicators of population status and distribution for Atlantic softpout, *Melanostigma atlanticum* (1971-2002).

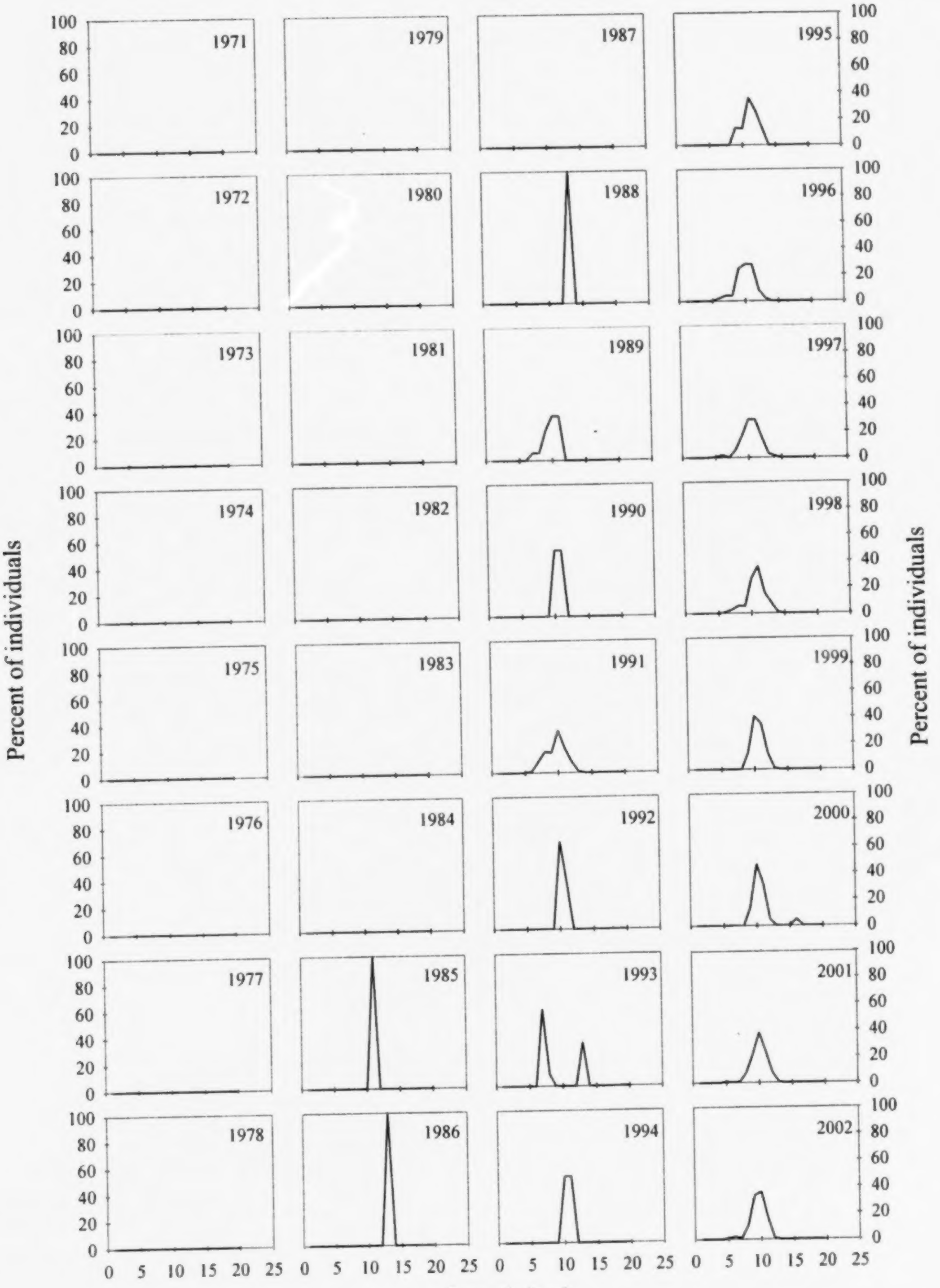

Figure 37b: Yearly length frequency distributions for Atlantic softpout (*Melanostigma atlanticum*).

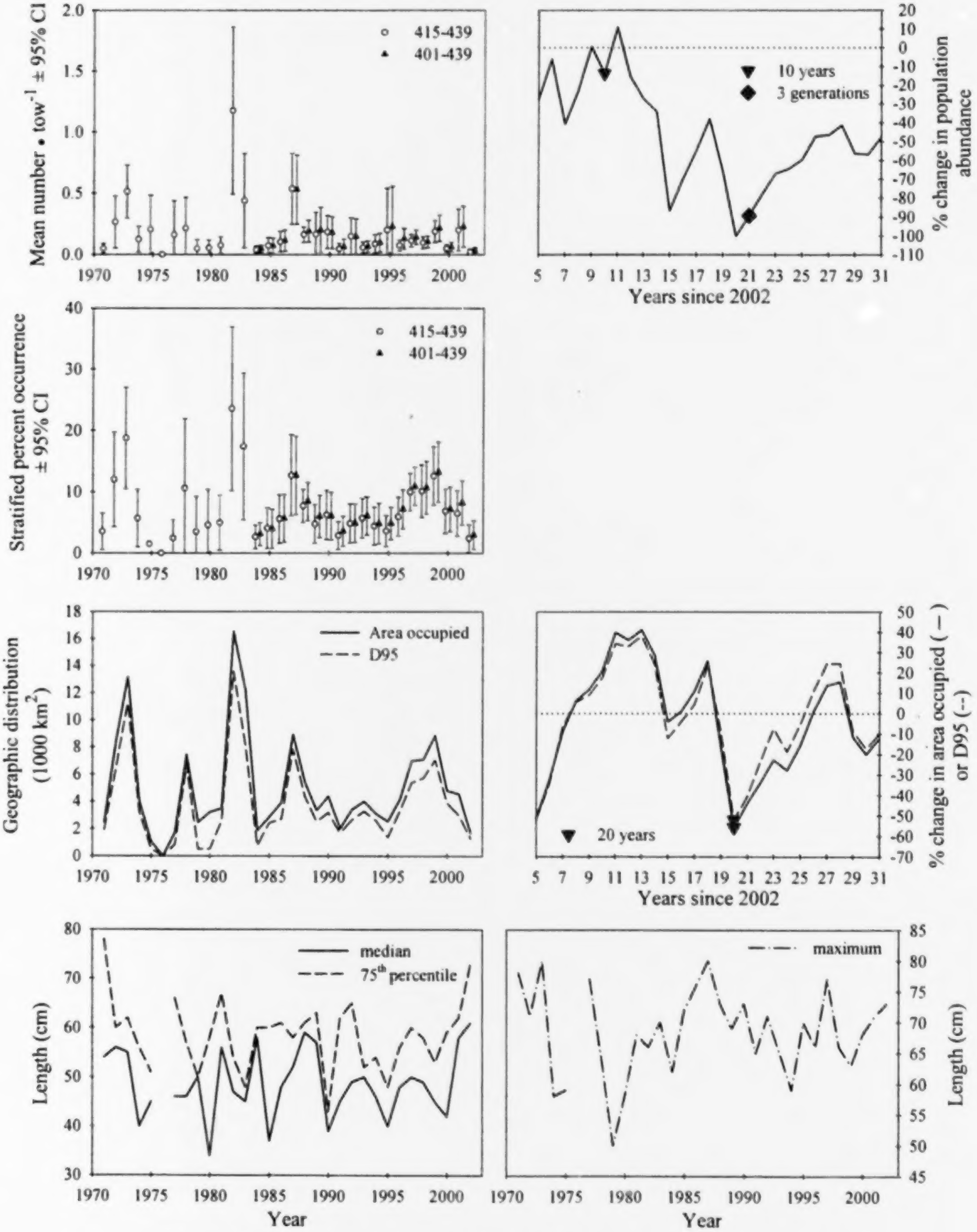

Figure 38a: Indicators of population status and distribution for common ocean pout, *Zoarces americanus* (1971-2002).

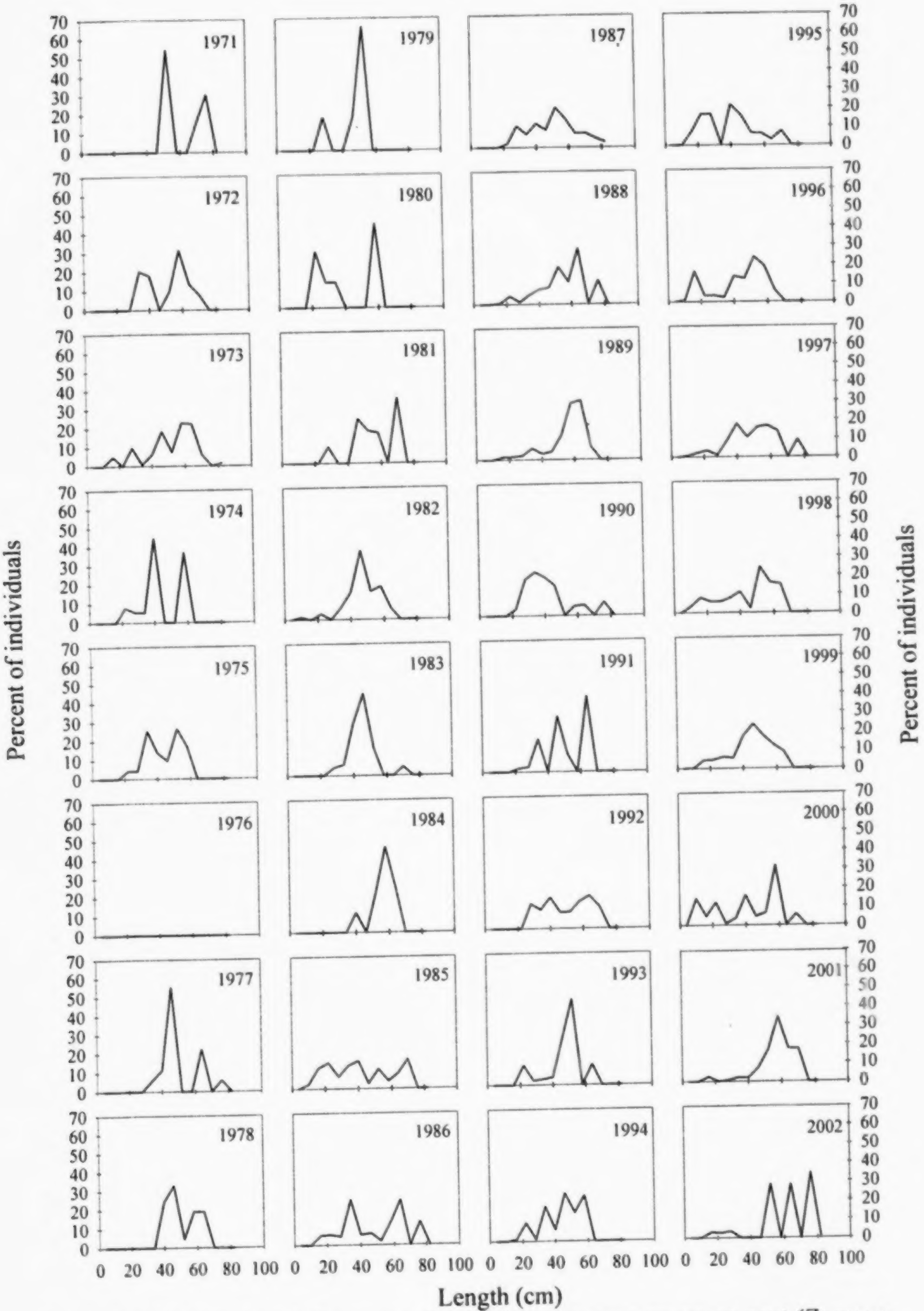

Figure 38b: Yearly length frequency distributions for common ocean pout (*Zoarces americanus*).

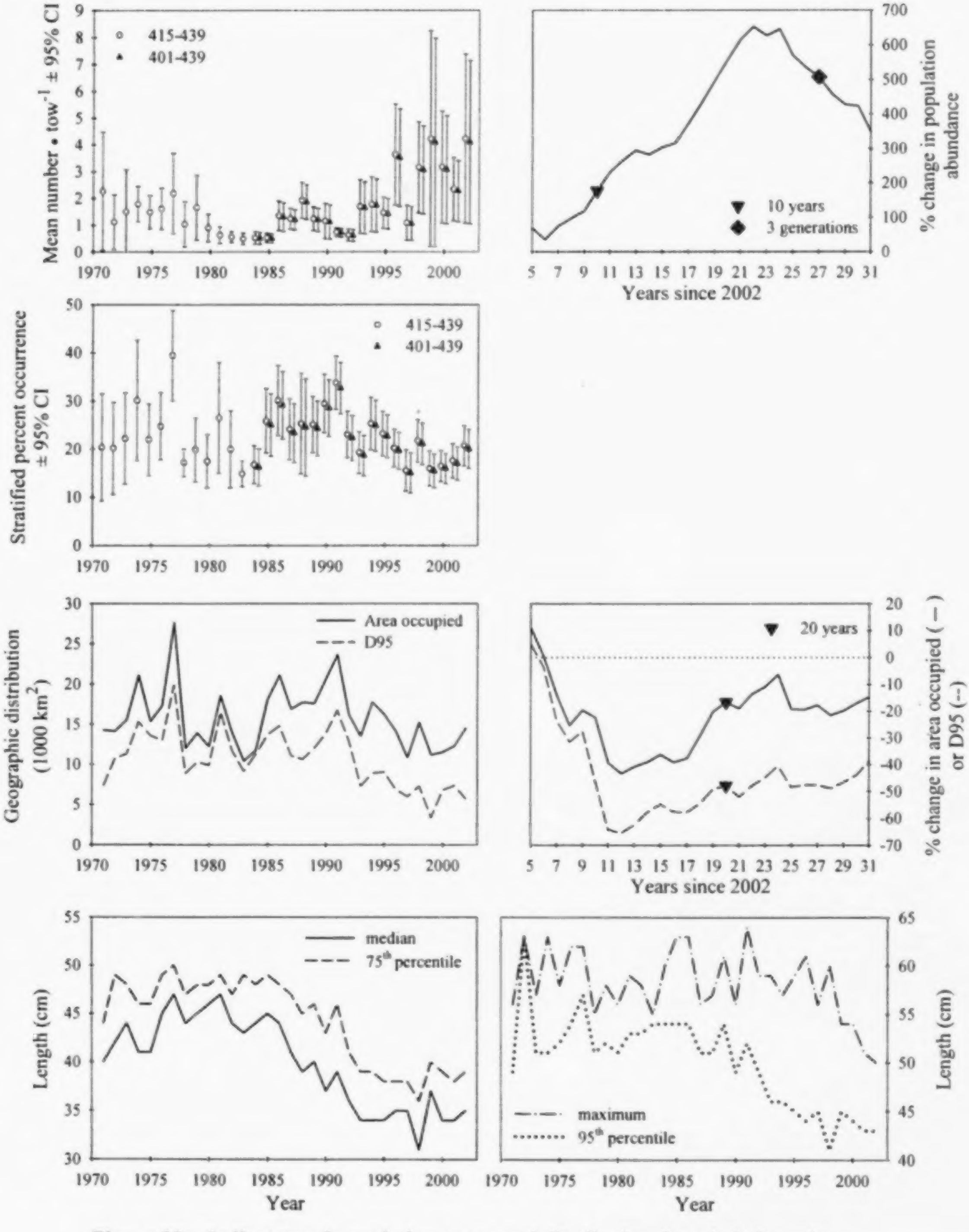

Figure 39a: Indicators of population status and distribution for witch flounder, *Glyptocephalus cynoglossus* (1971-2002).

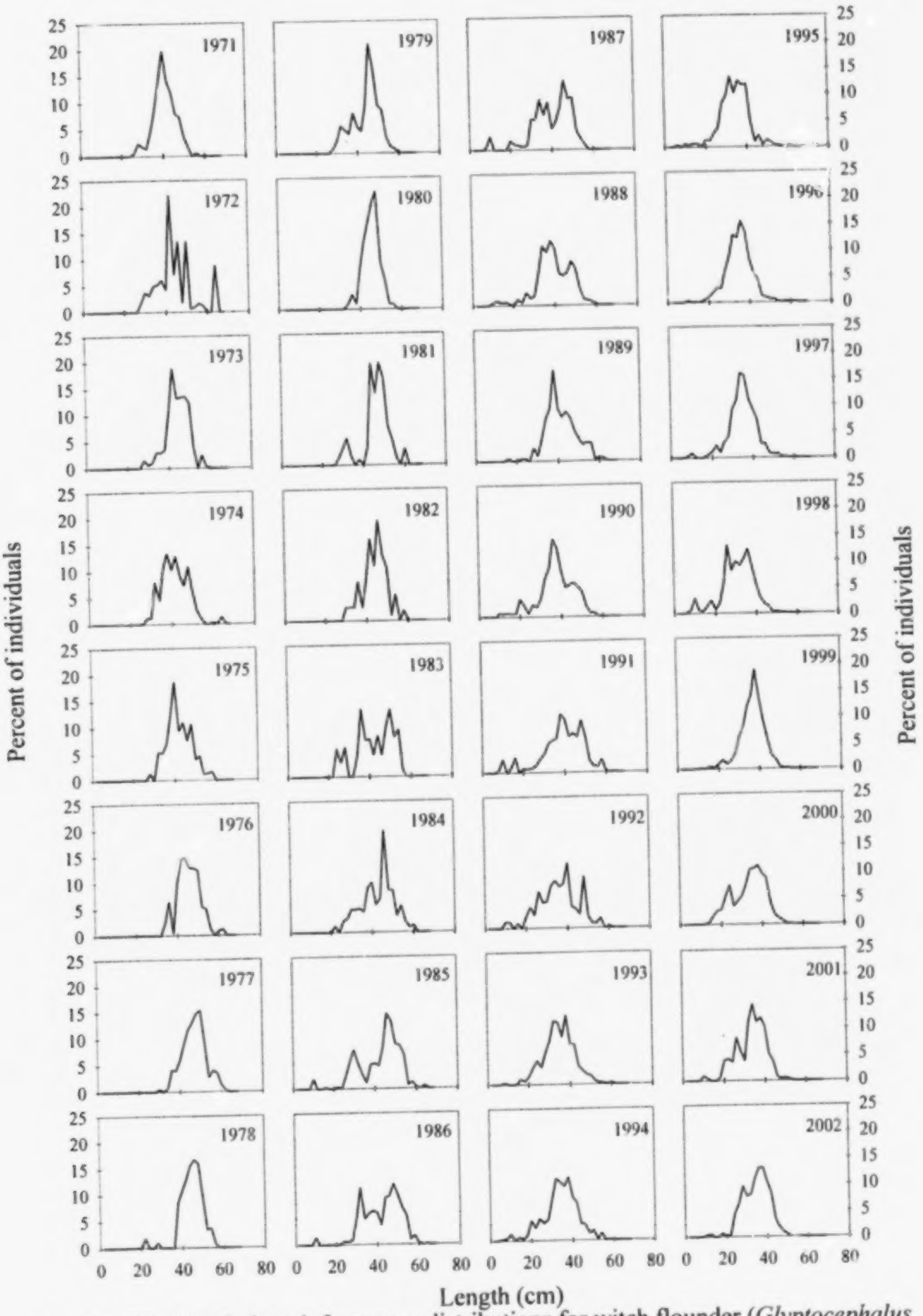

Figure 39b: Yearly length frequency distributions for witch flounder (*Glyptocephalus cynoglossus*).

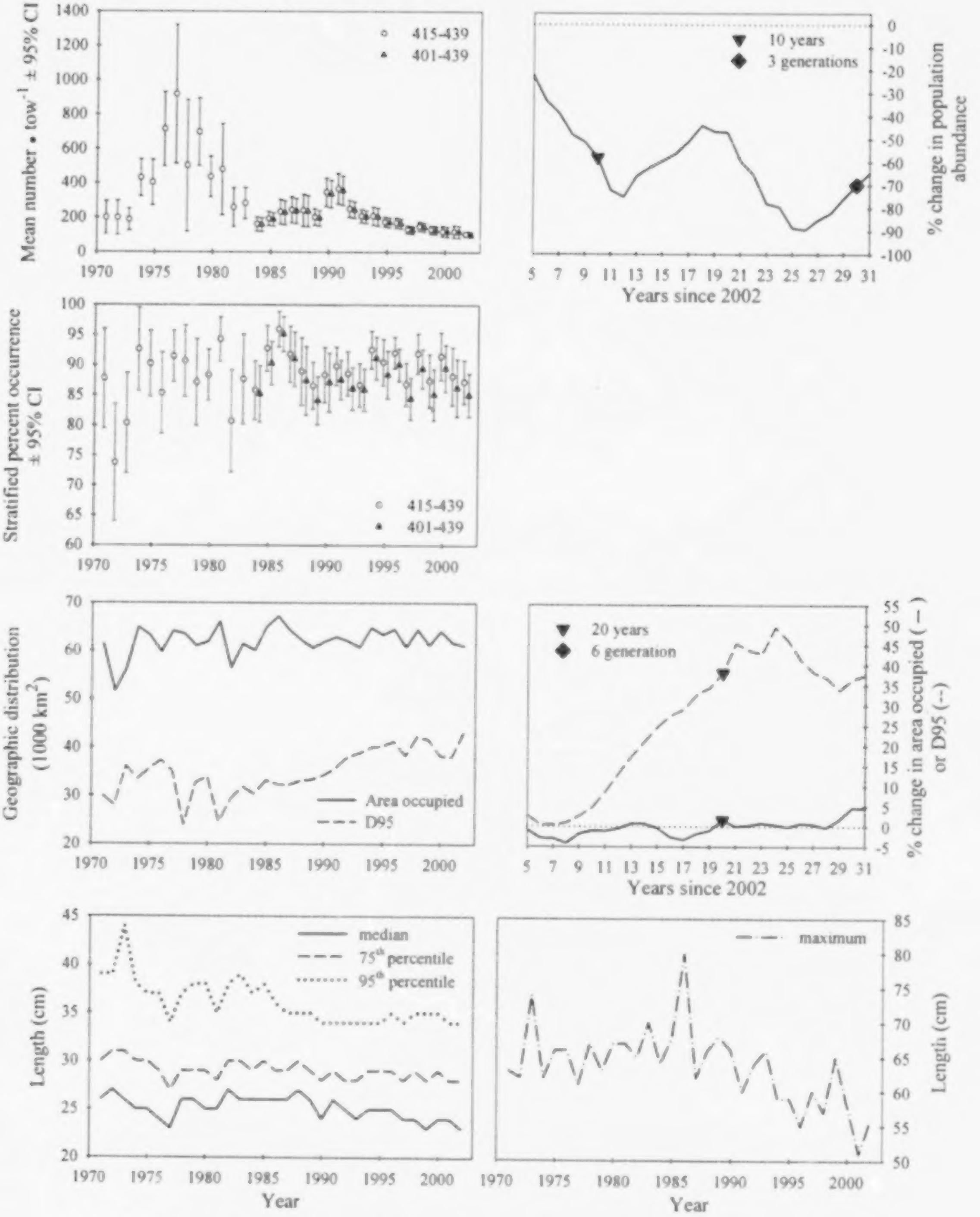

Figure 40a: Indicators of population status and distribution for American plaice, *Hippoglossoides platessoides* (1971-2002).

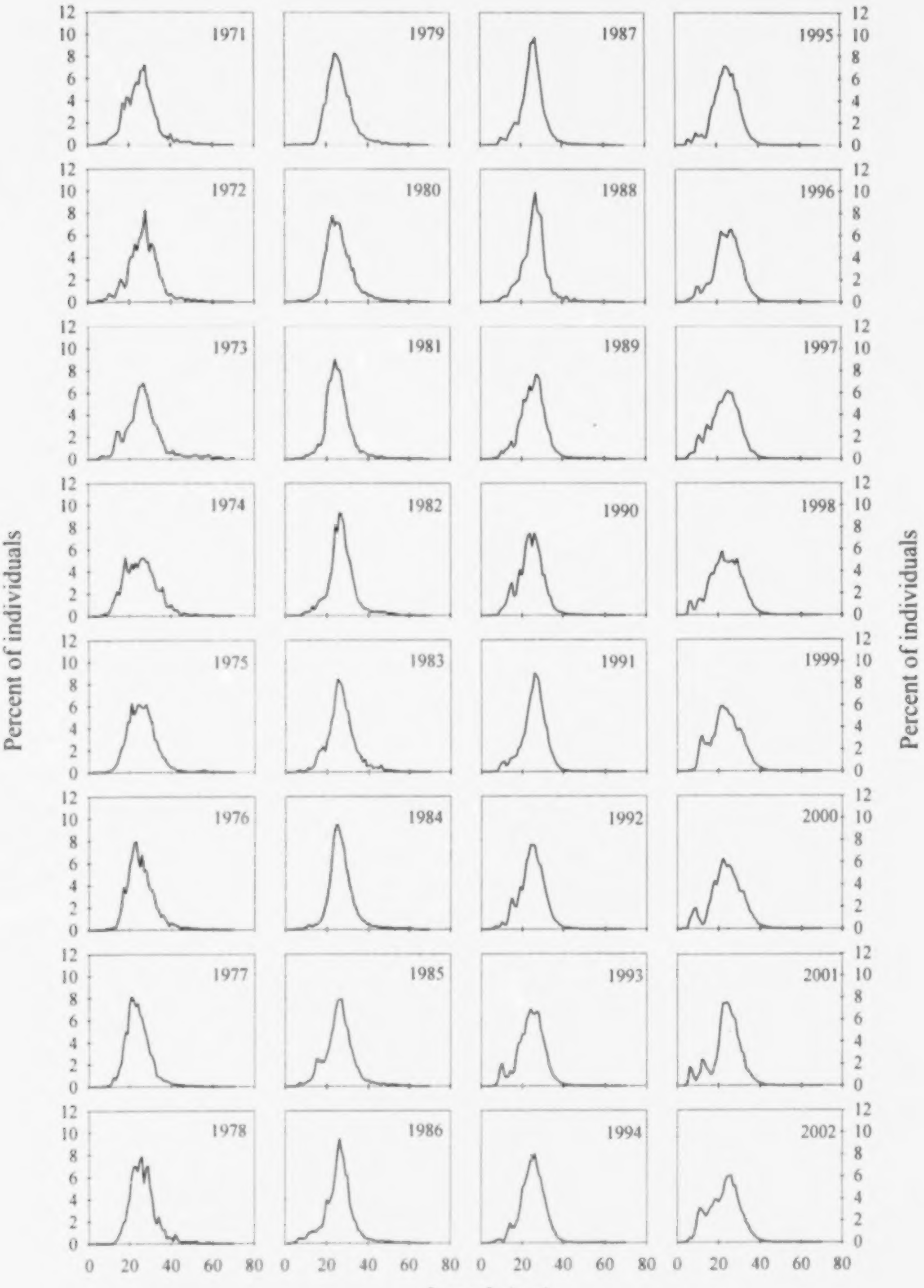

Figure 40b: Yearly length frequency distributions for American plaice (*Hippoglossoides platessoides*).

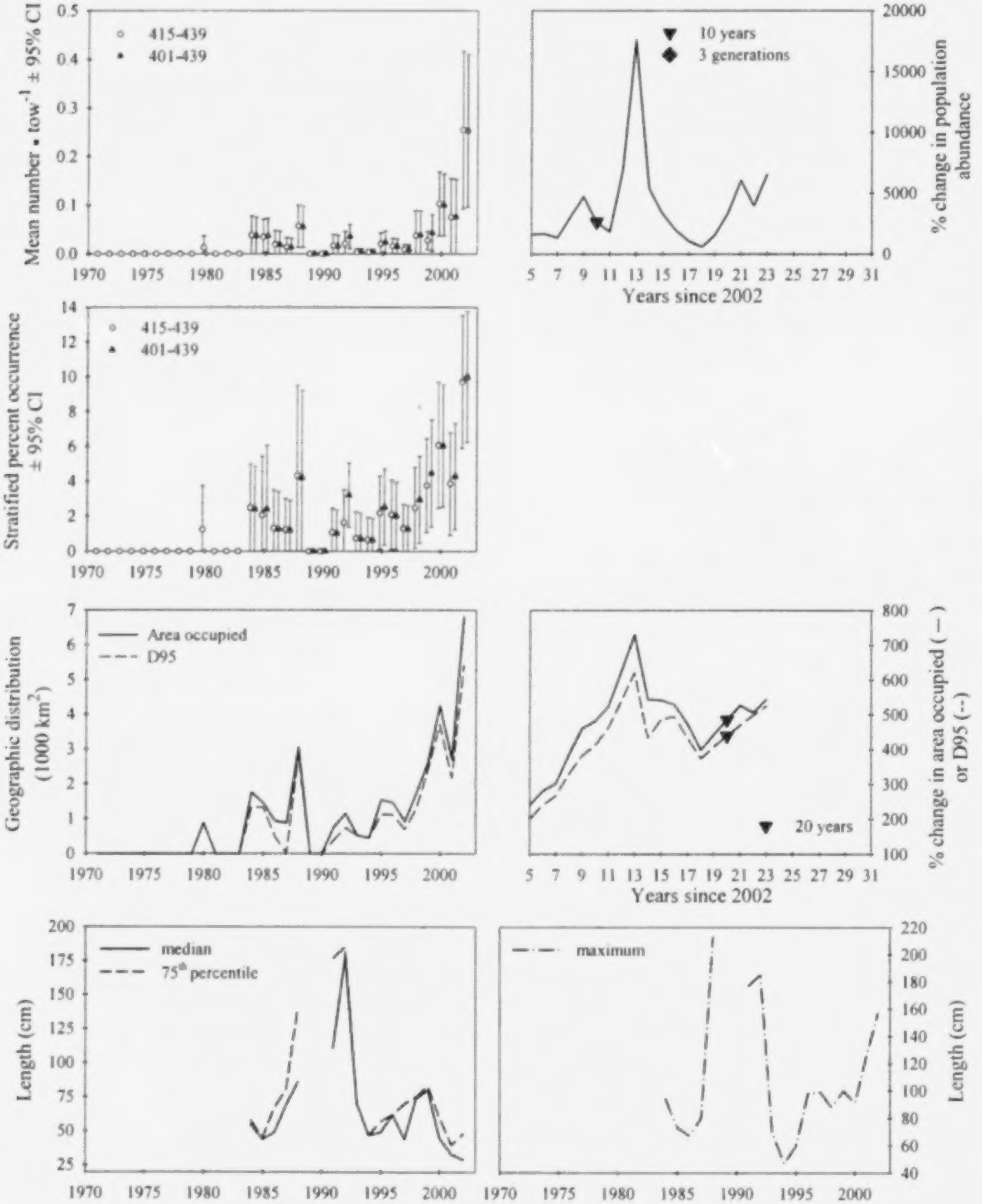

Figure 41a: Indicators of population status and distribution for Atlantic halibut, *Hippoglossus hippoglossus* (1971-2002).

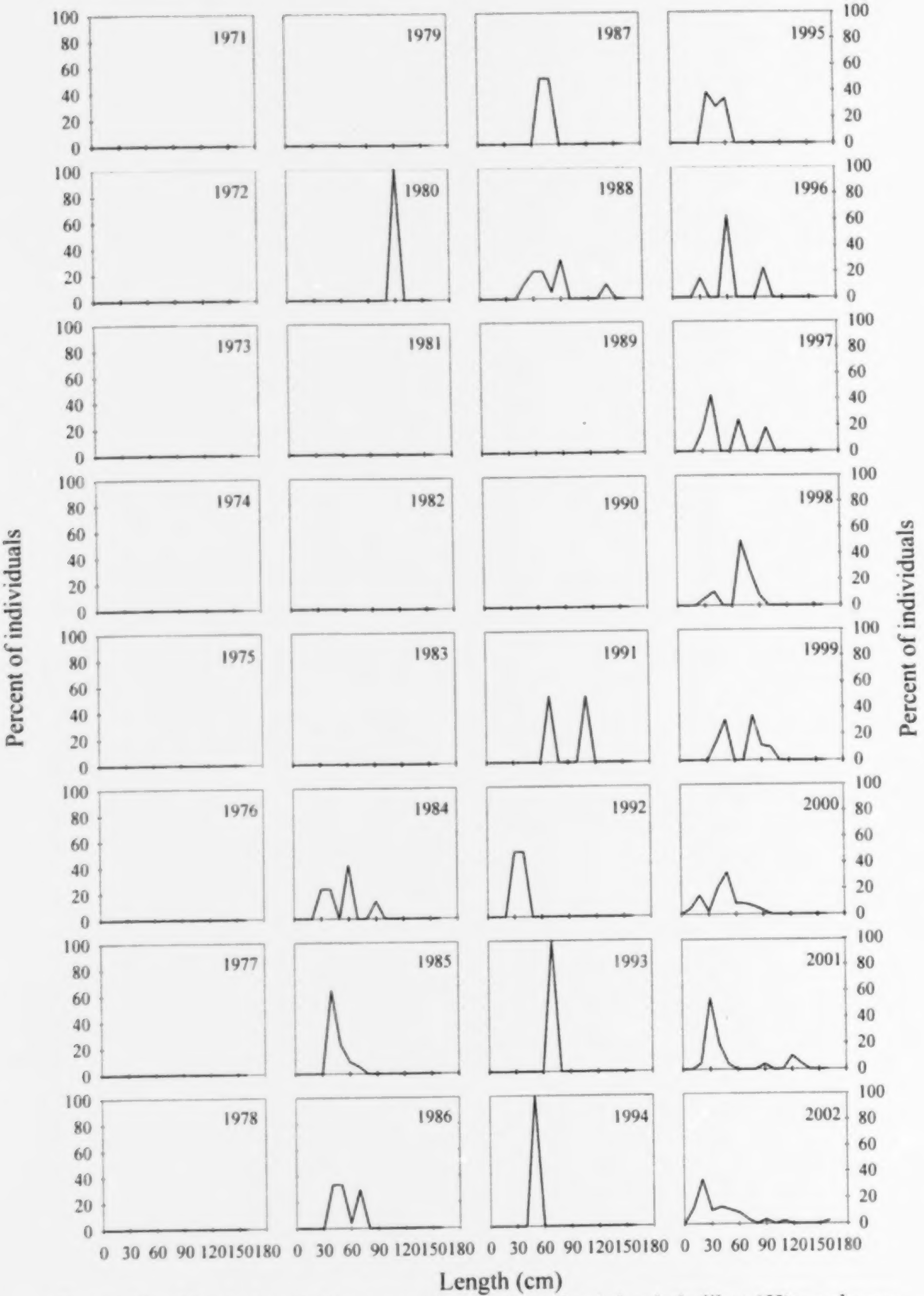

Figure 41b: Yearly length frequency distributions for Atlantic halibut (*Hippoglossus hippoglossus*).

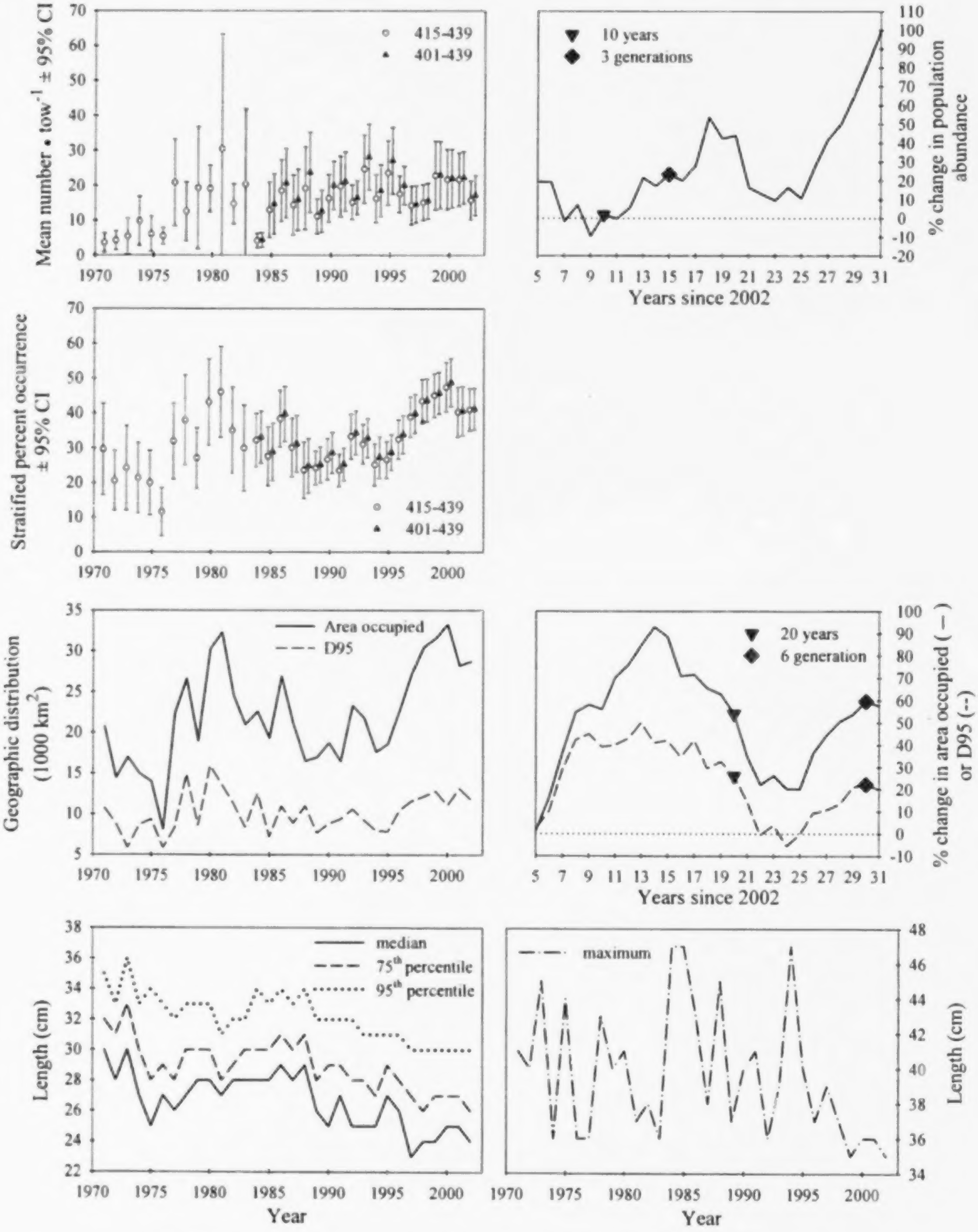

Figure 42a: Indicators of population status and distribution for yellowtail flounder, *Limanda ferruginea* (1971-2002).

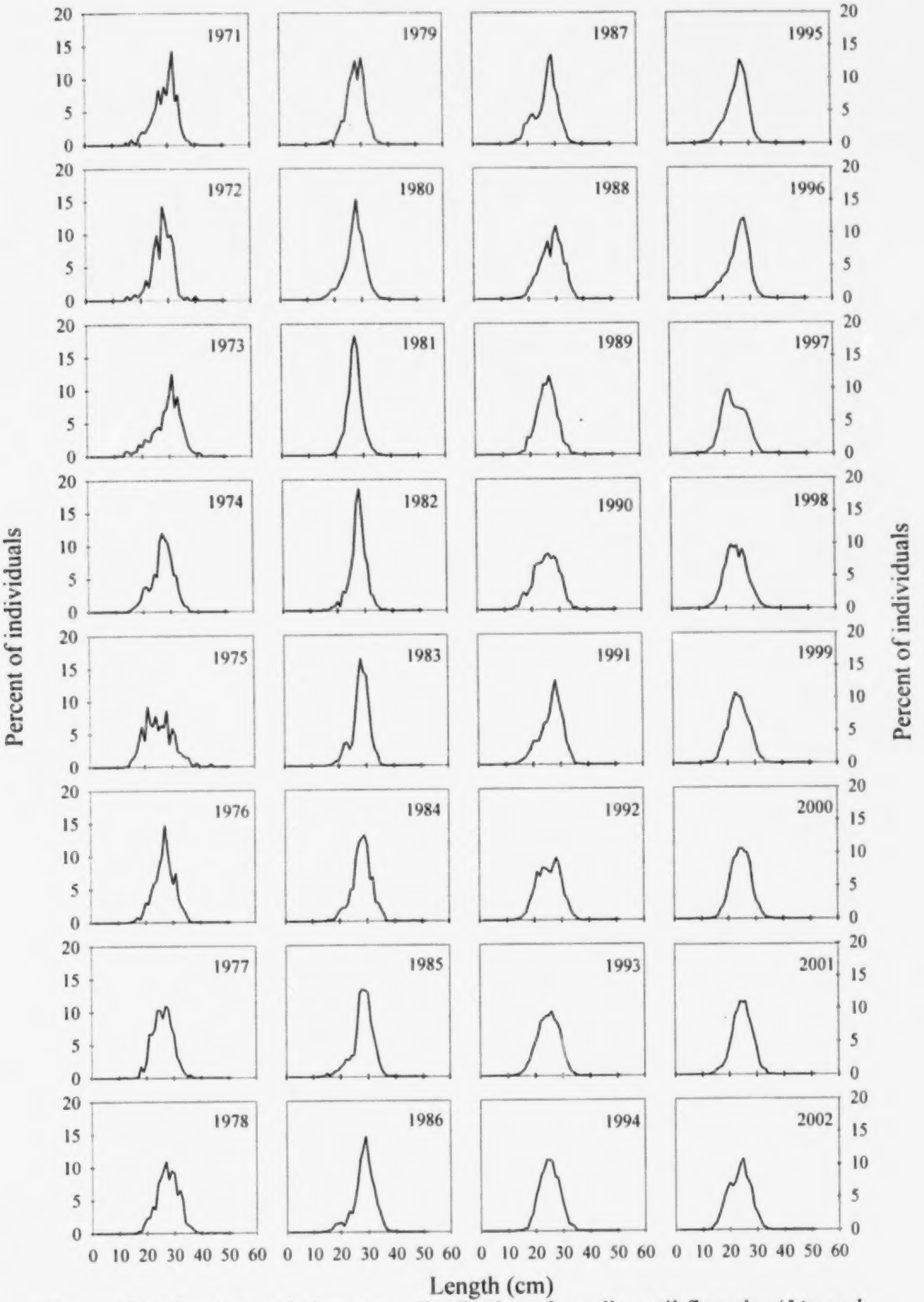

Figure 42b: Yearly length frequency distributions for yellowtail flounder (*Limanda ferruginea*).

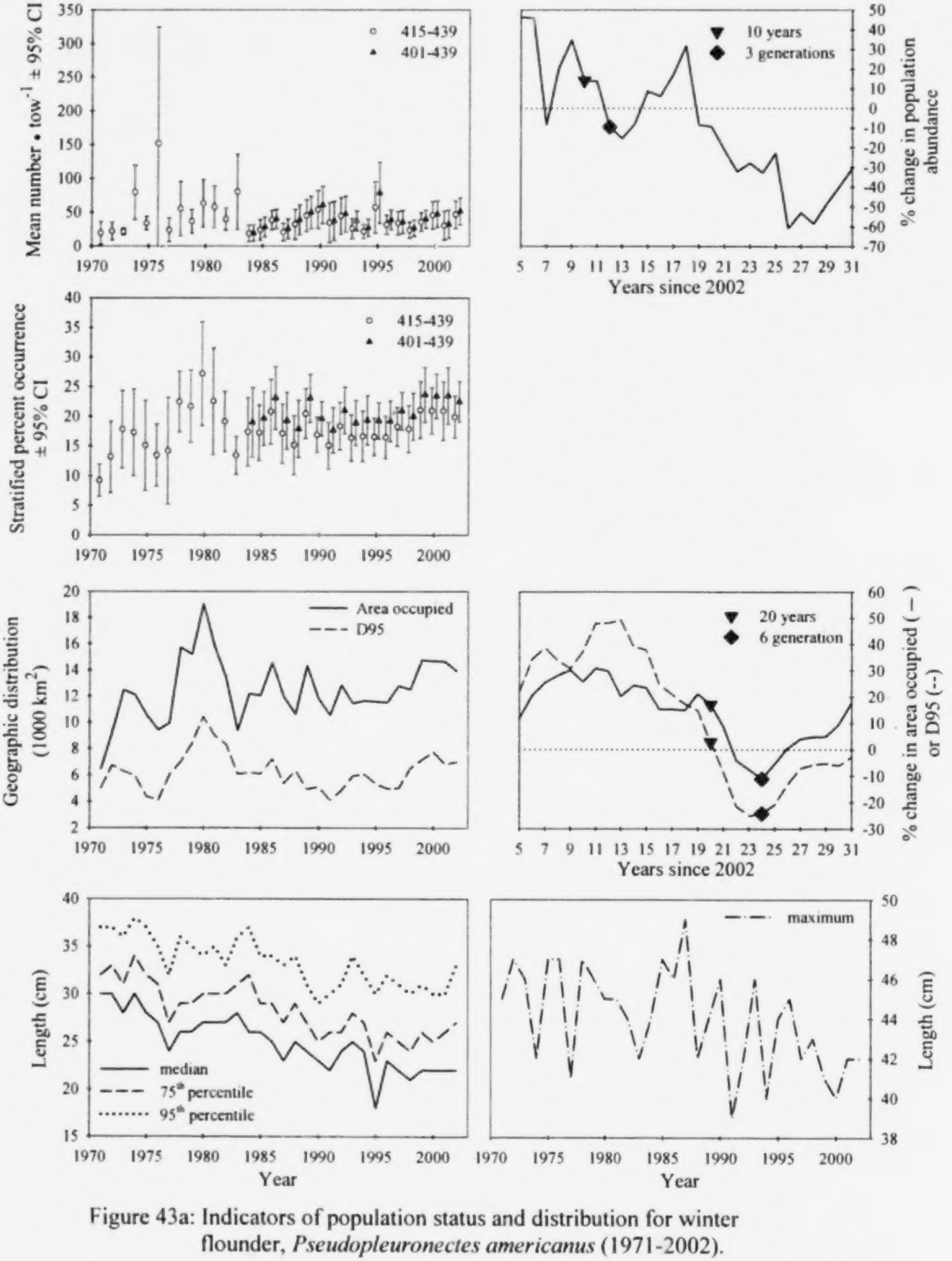

Figure 43a: Indicators of population status and distribution for winter flounder, *Pseudopleuronectes americanus* (1971-2002).

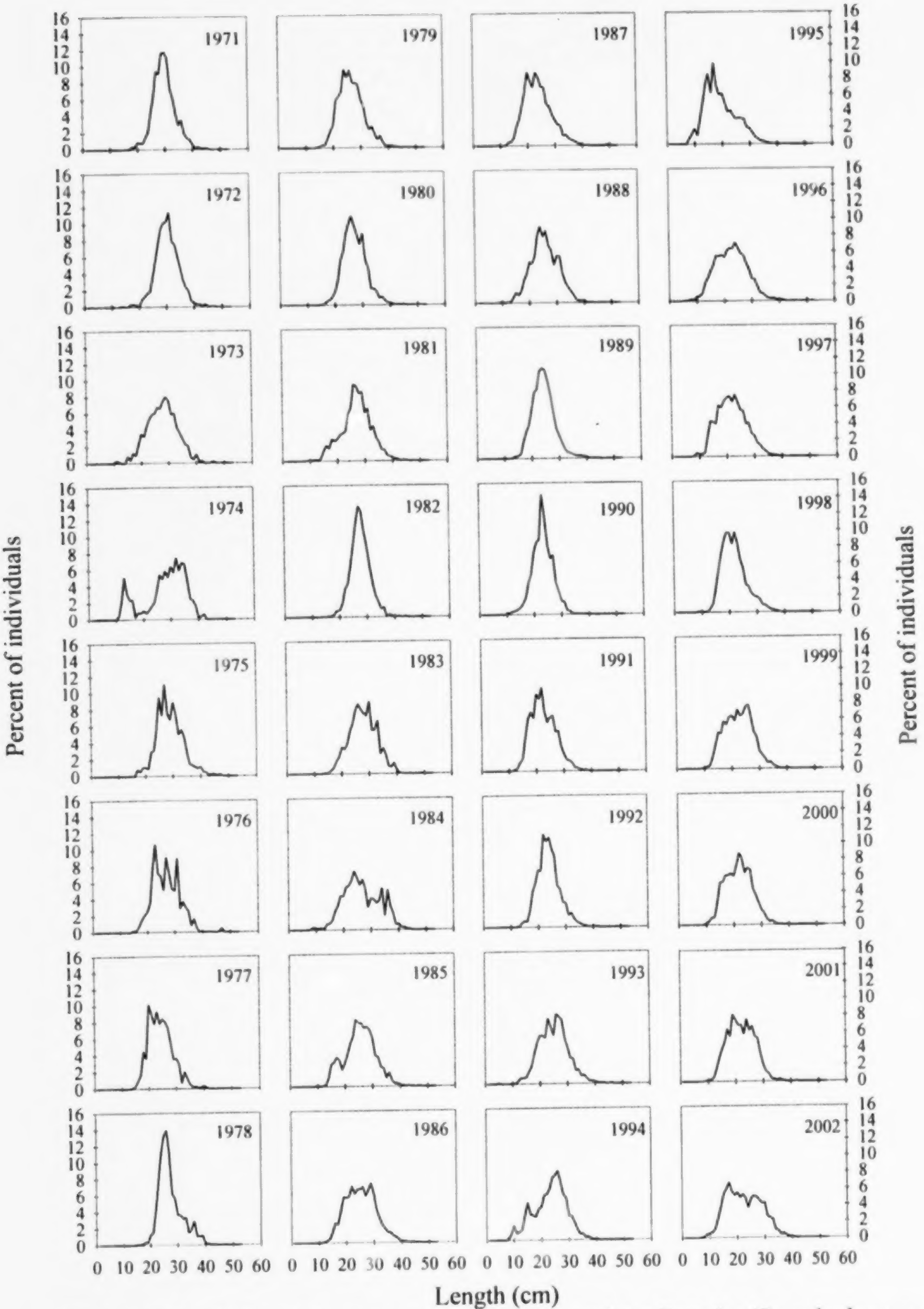

Figure 43b: Yearly length frequency distributions for winter flounder (*Pseudopleuronectes americanus*).

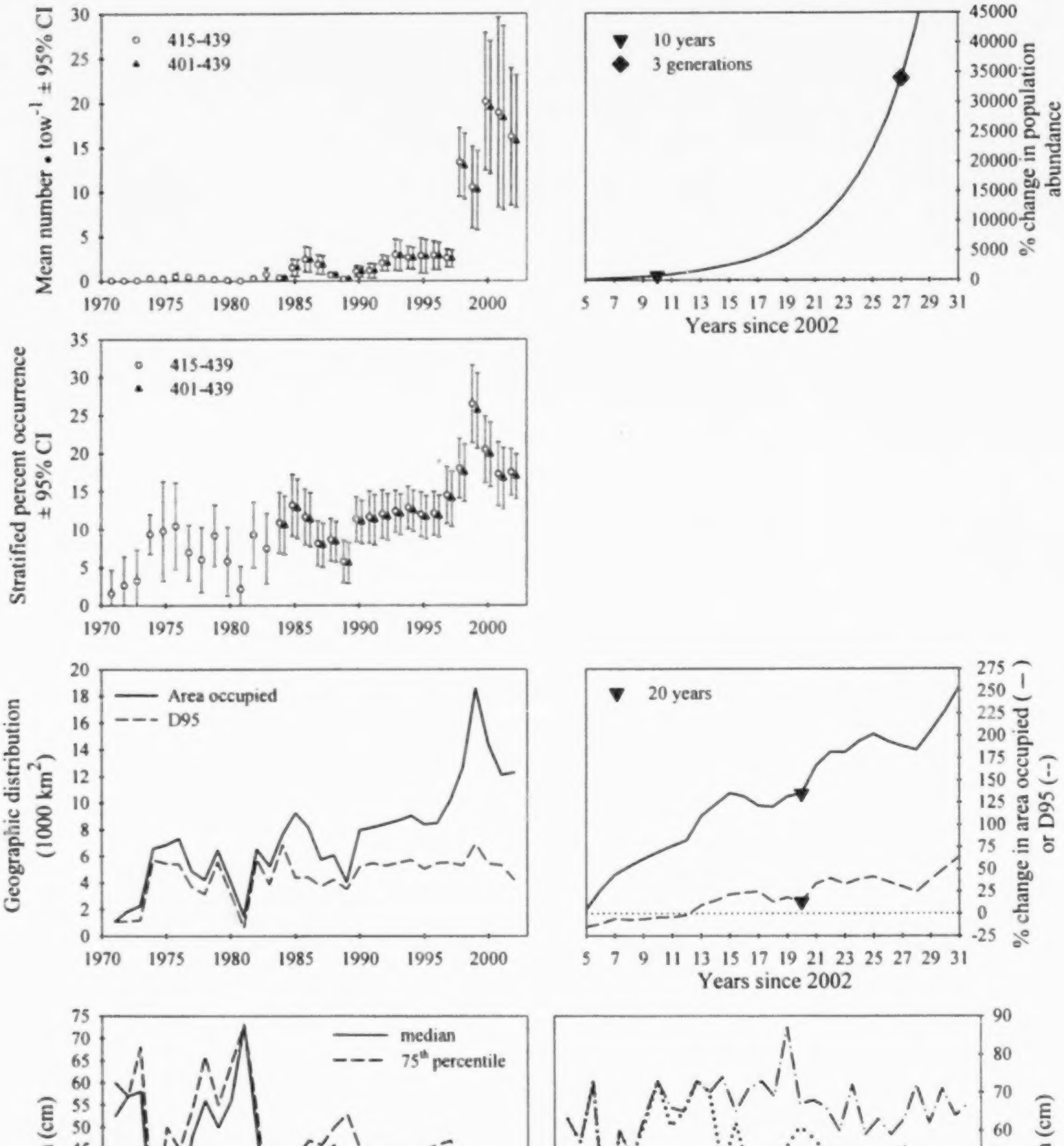

Figure 44a: Indicators of population status and distribution for Greenland halibut, *Reinhardtius hippoglossoides* (1971-2002).

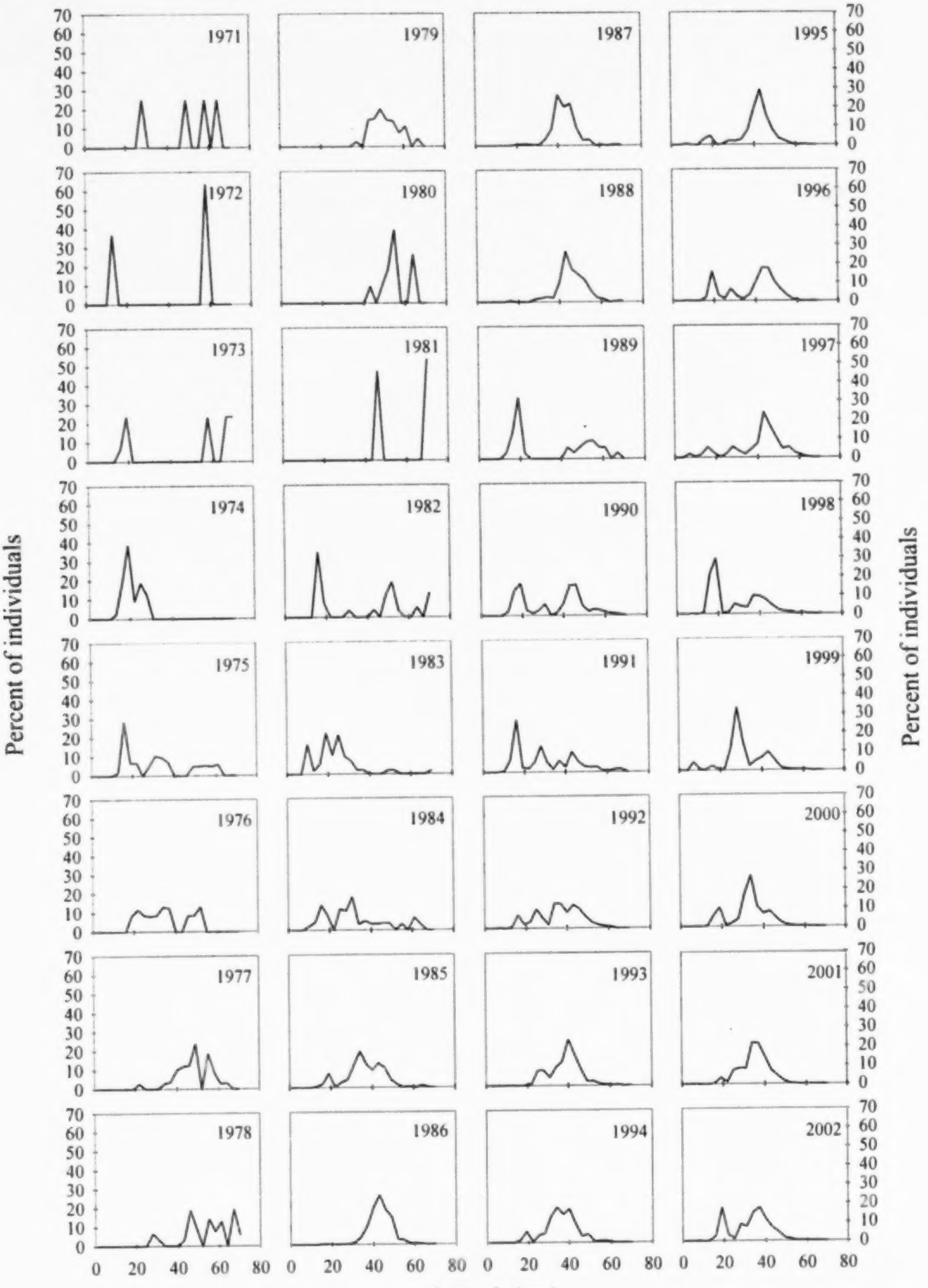

Figure 44b: Yearly length frequency distributions for Greenland halibut (*Reinhardtius hippoglossoides*).

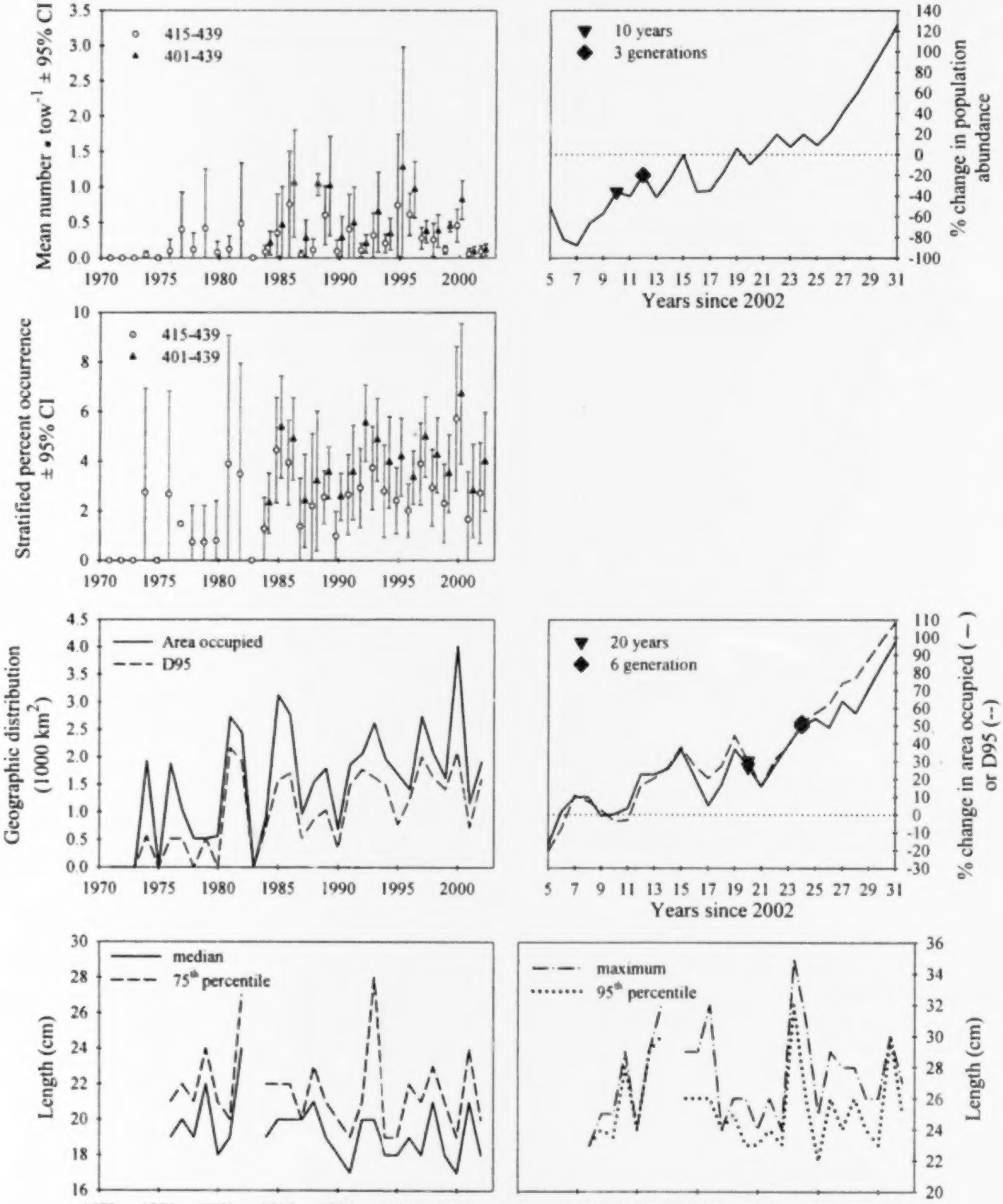

Figure 45a: Indicators of population status and distribution for windowpane, *Scophthalmus aquosus* (1971-2002).

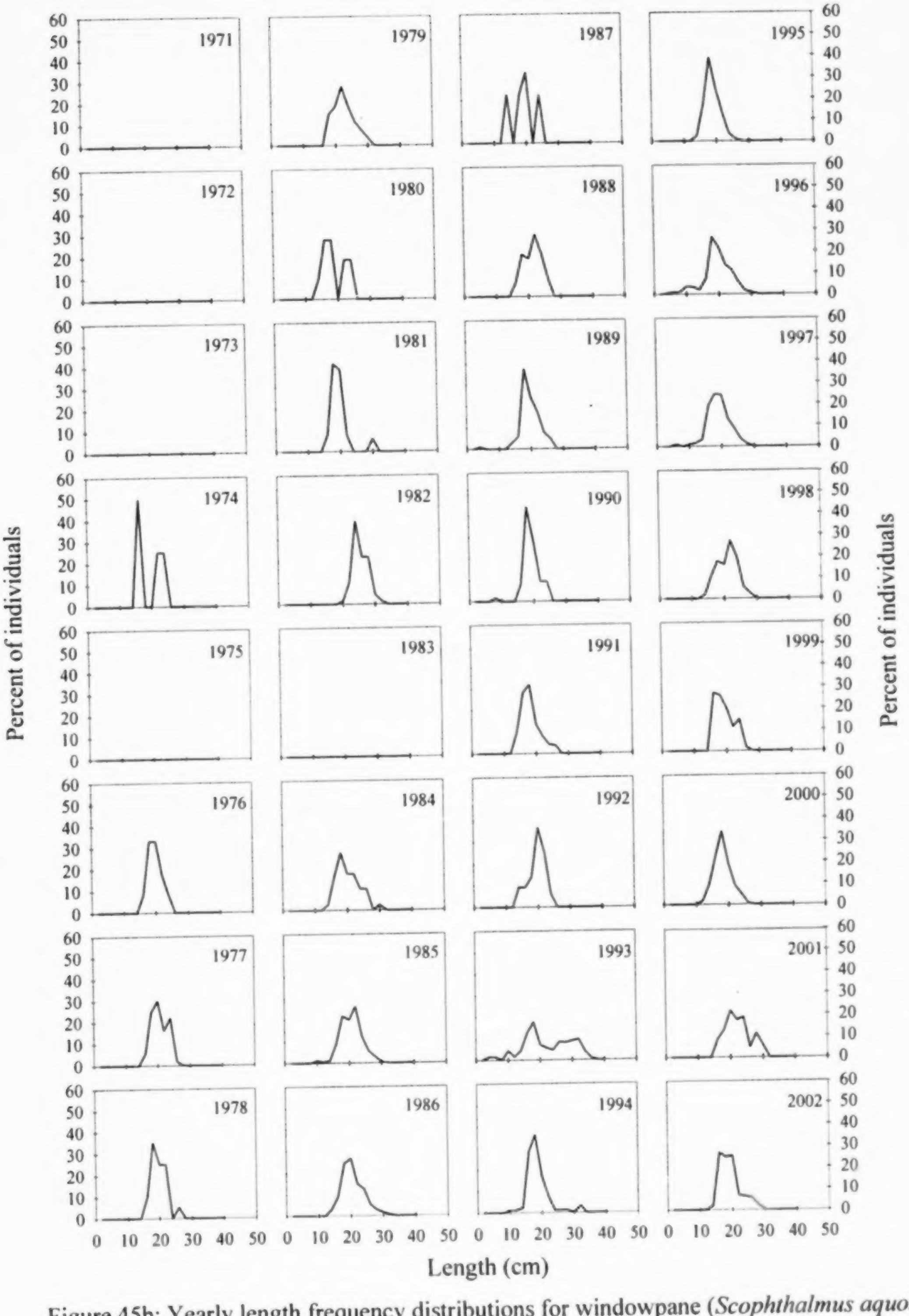

Figure 45b: Yearly length frequency distributions for windowpane (*Scophthalmus aquosus*).

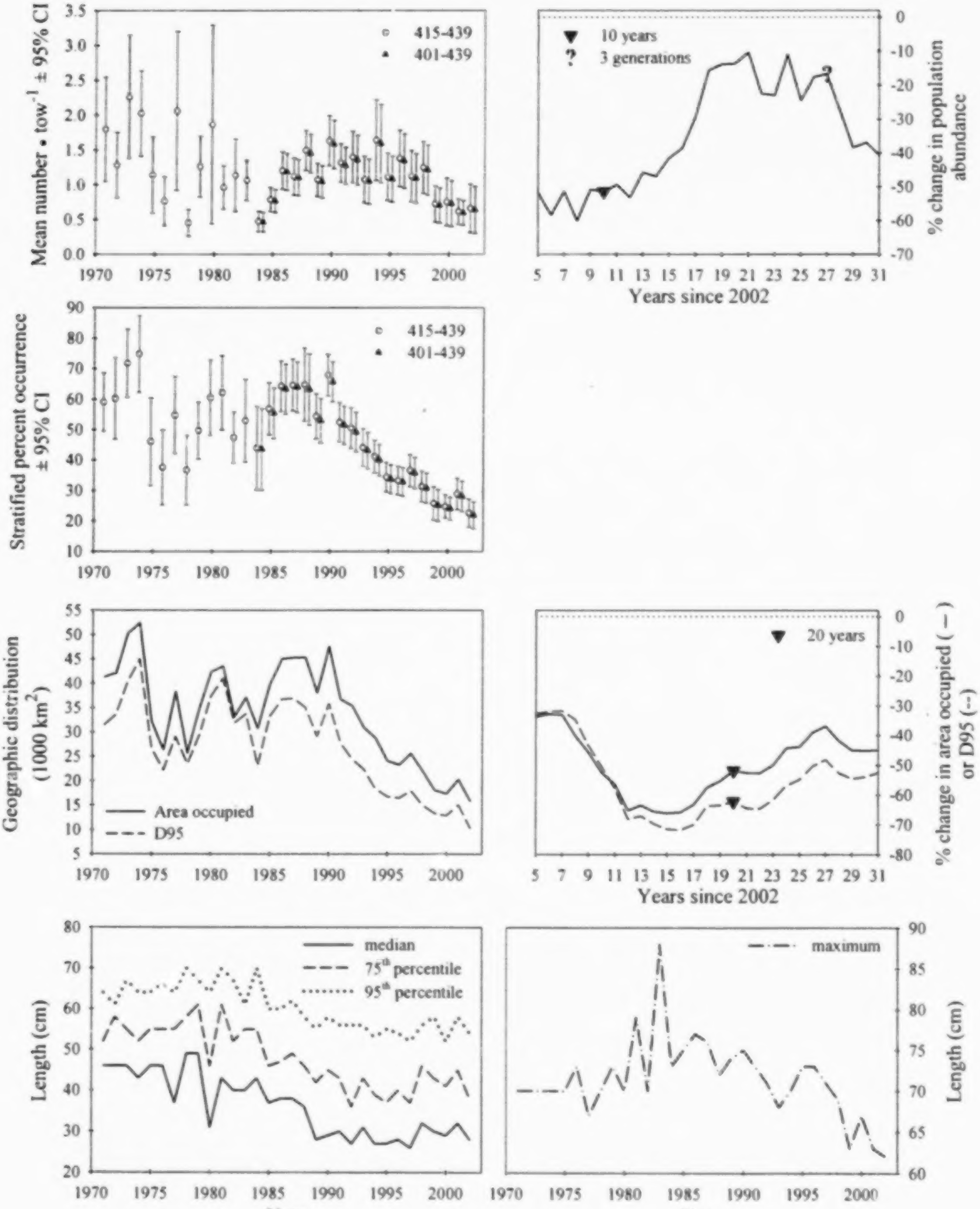

Figure 46a: Indicators of population status and distribution for thorny skate, *Amblyraja radiata* (1971-2002).

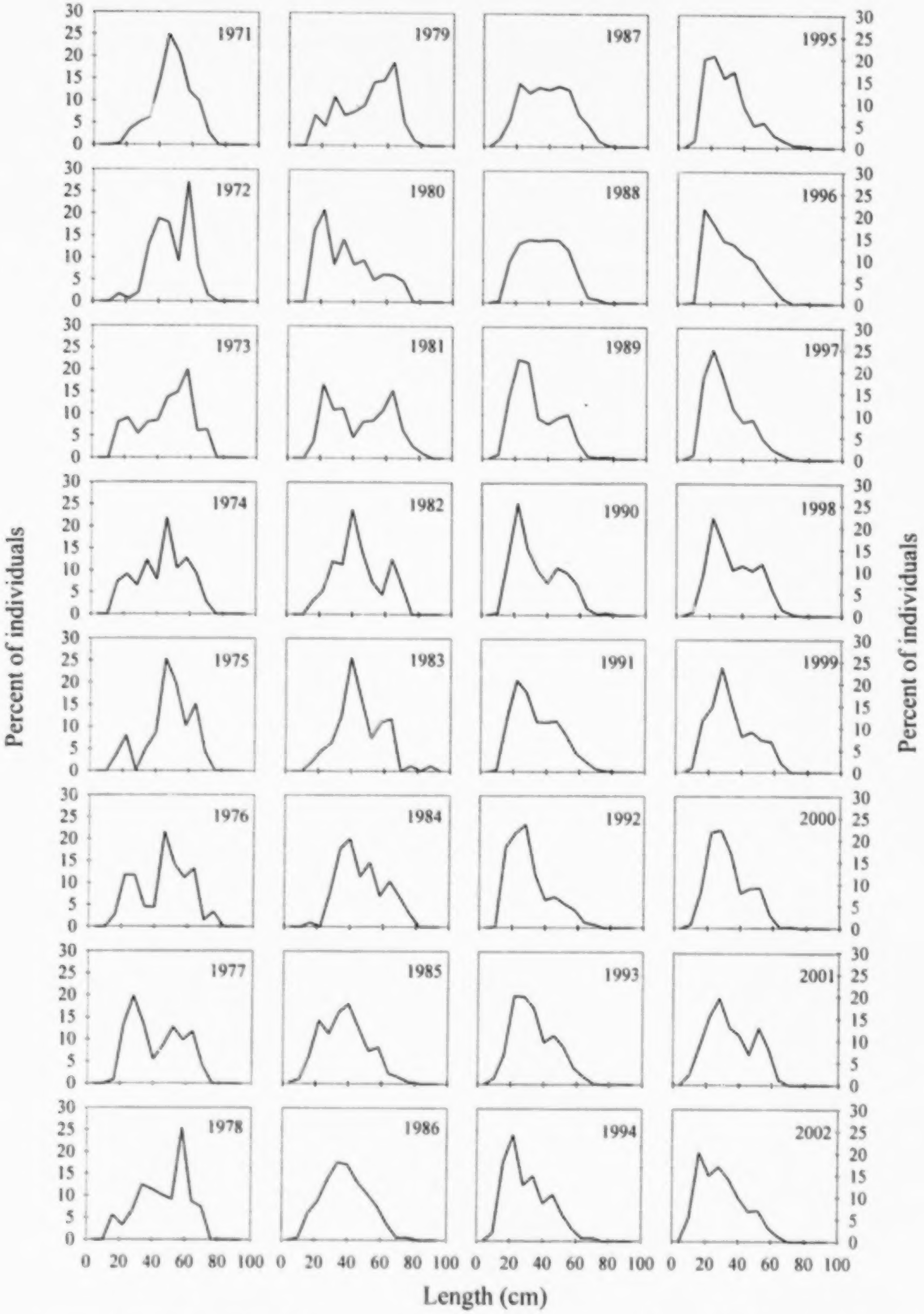

Figure 46b: Yearly length frequency distributions for thorny skate (*Amblyraja radiata*).

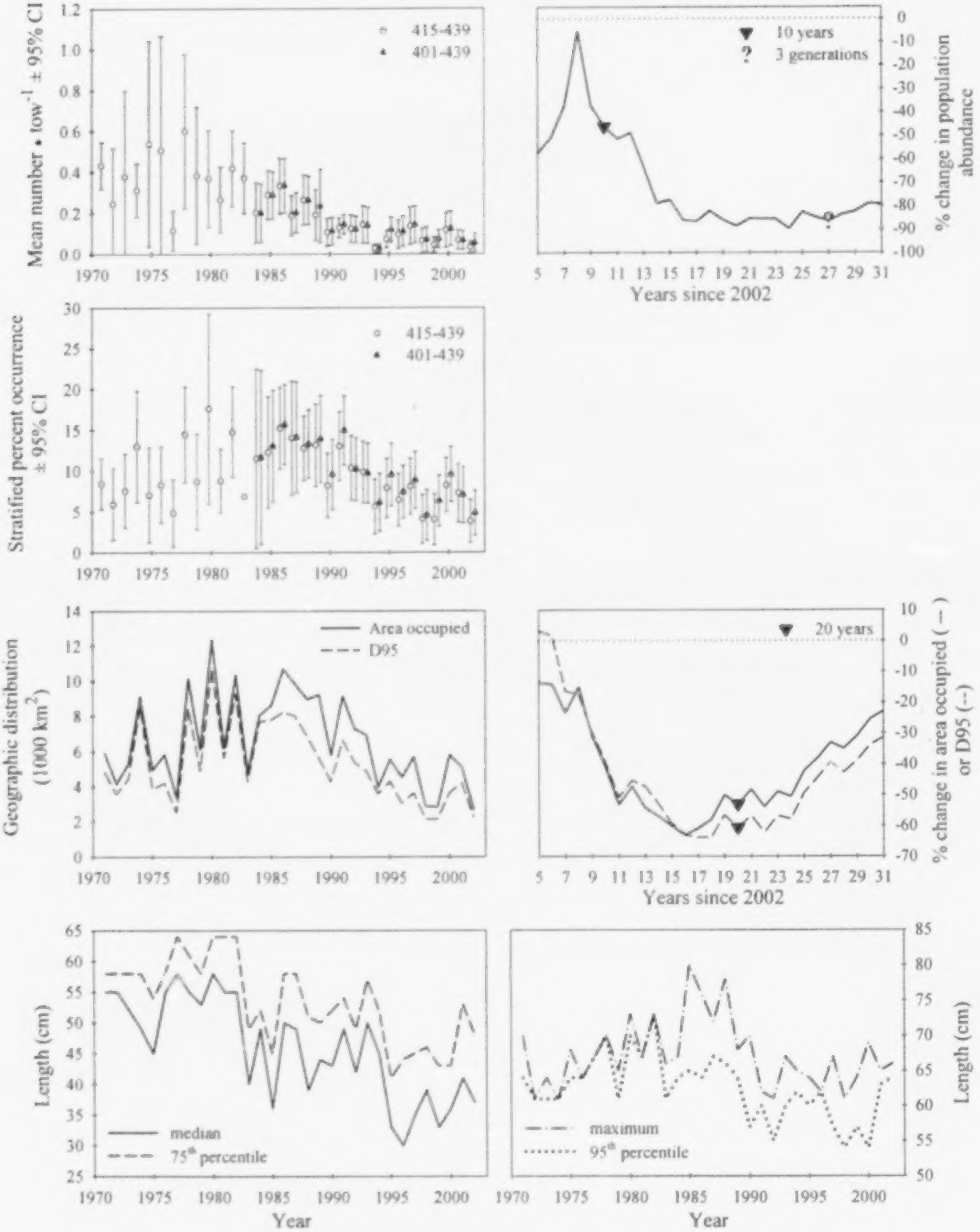

Figure 47a: Indicators of population status and distribution for winter skate, *Leucoraja ocellata* (1971-2002).

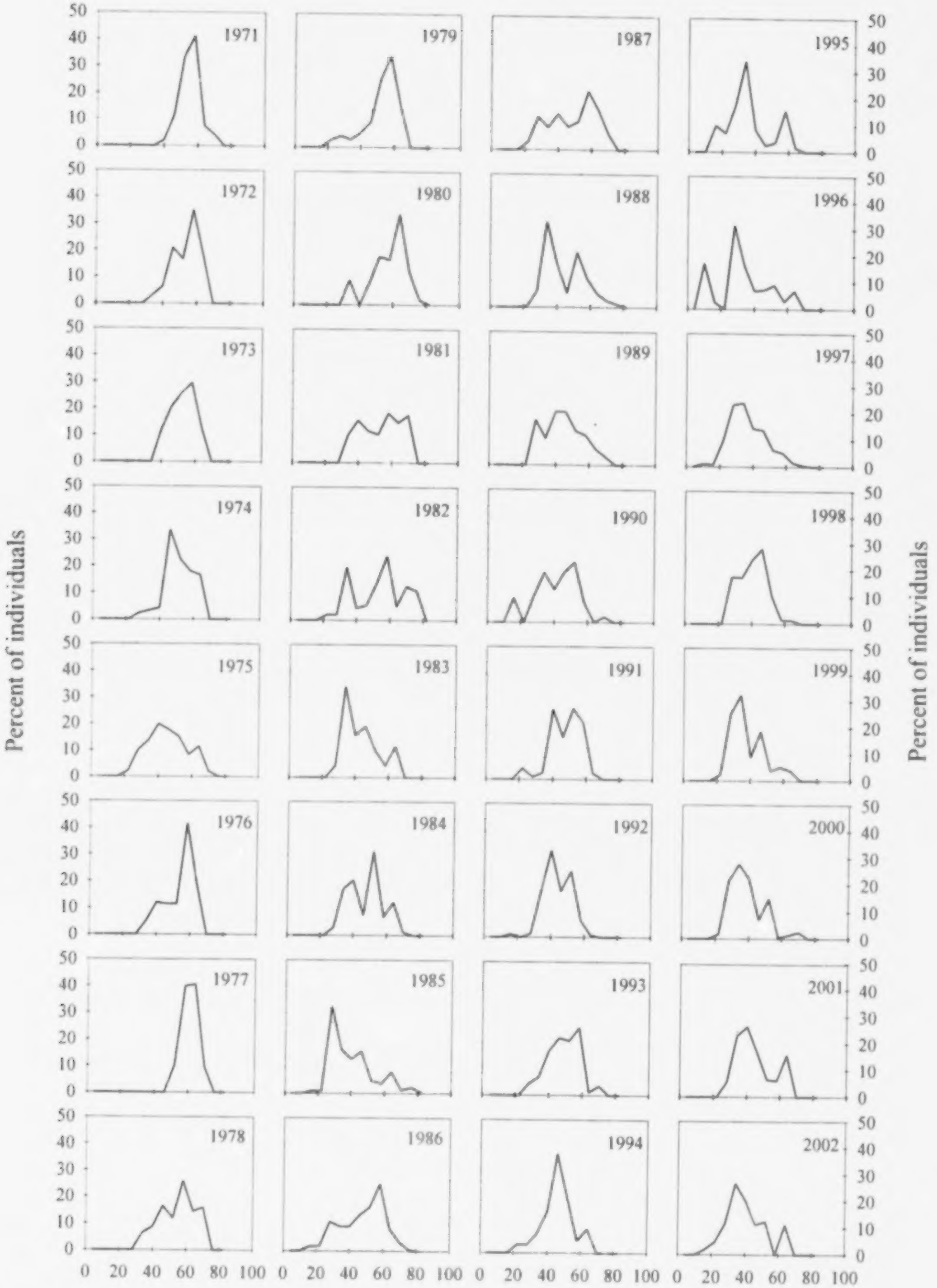

Figure 47b: Yearly length frequency distributions for winter skate (*Leucoraja ocellata*).

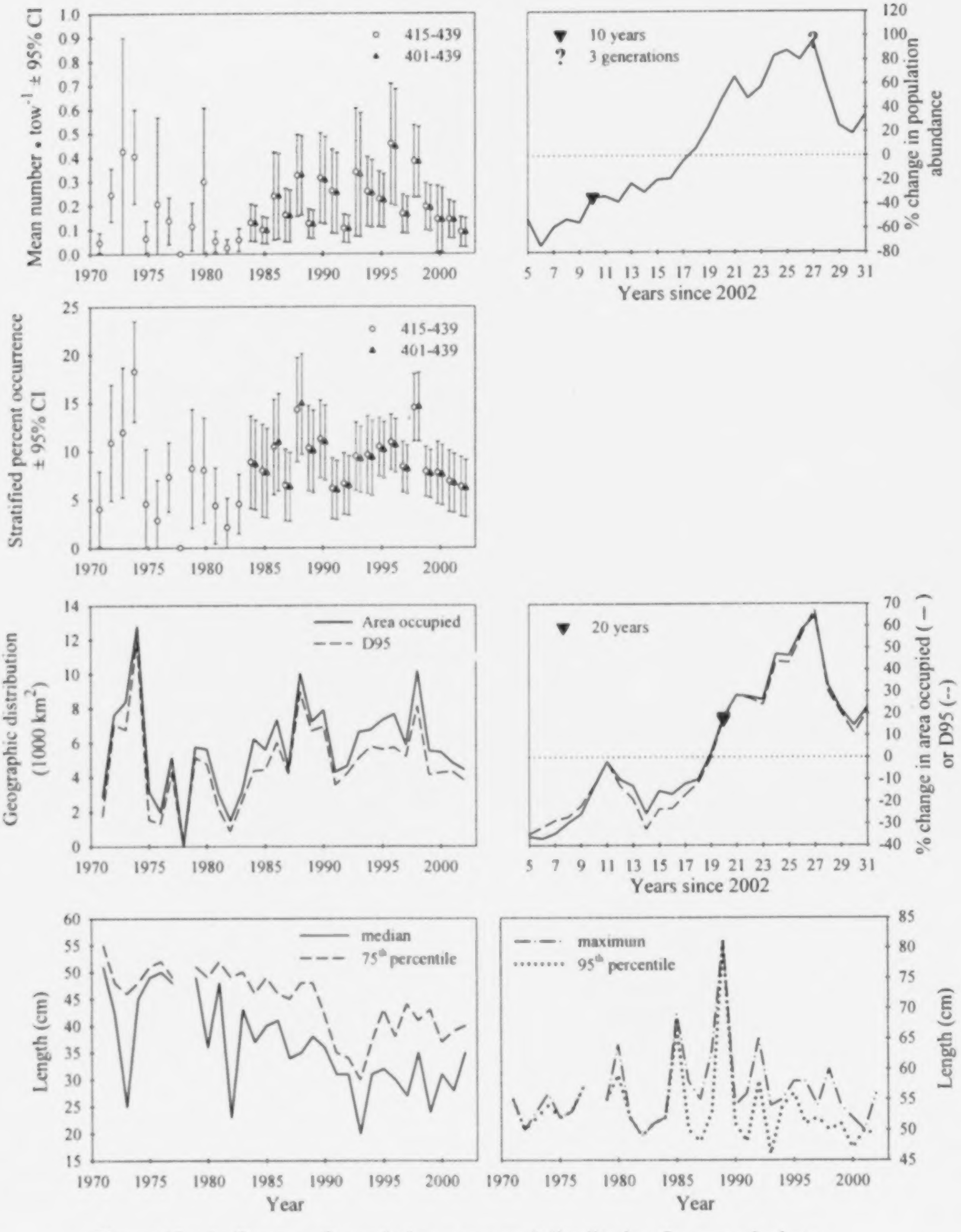

Figure 48a: Indicators of population status and distribution for smooth skate, *Malacoraja senta* (1971-2002).

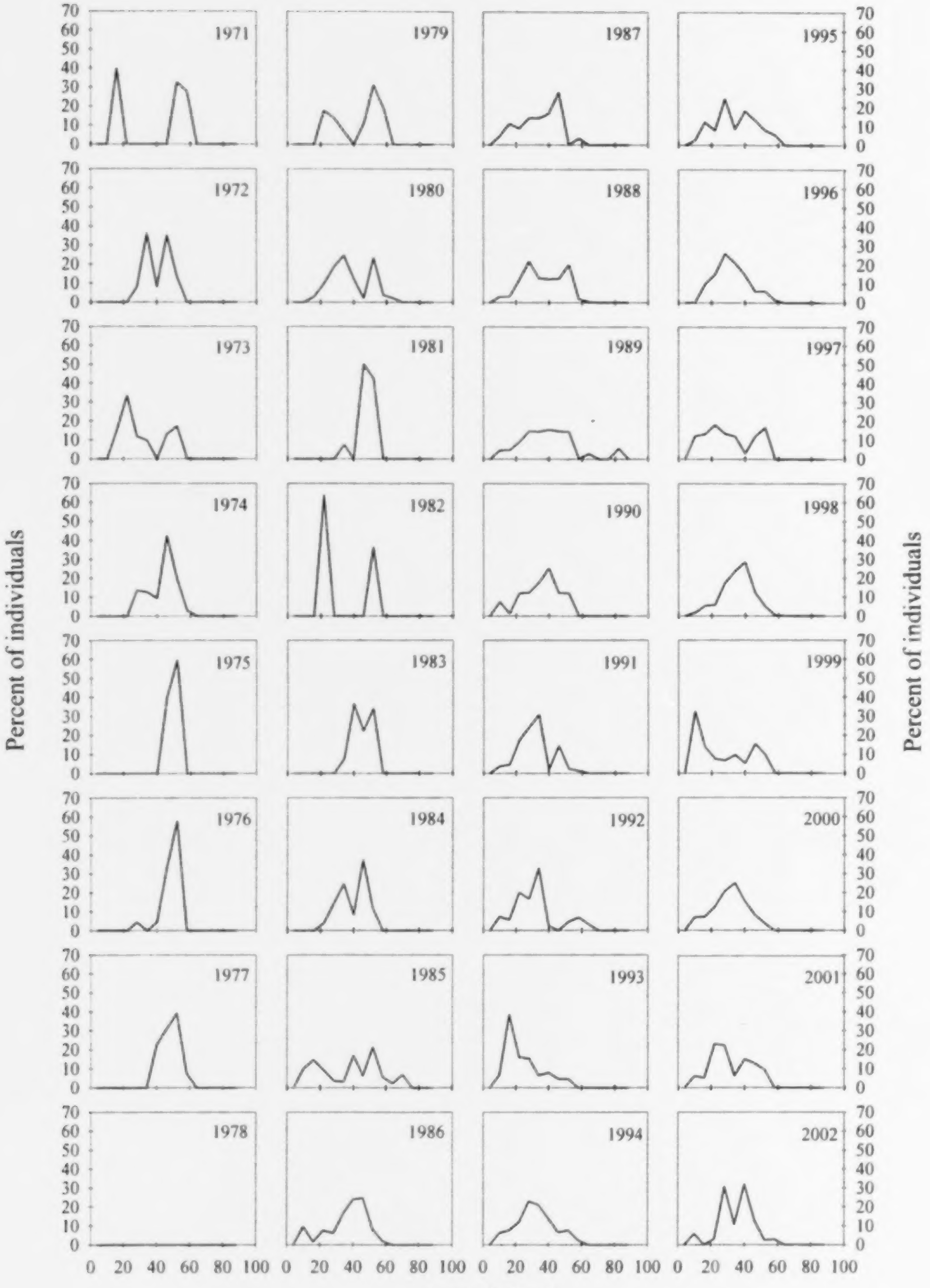

Figure 48b: Yearly length frequency distributions for smooth skate (*Malacoraja senta*).

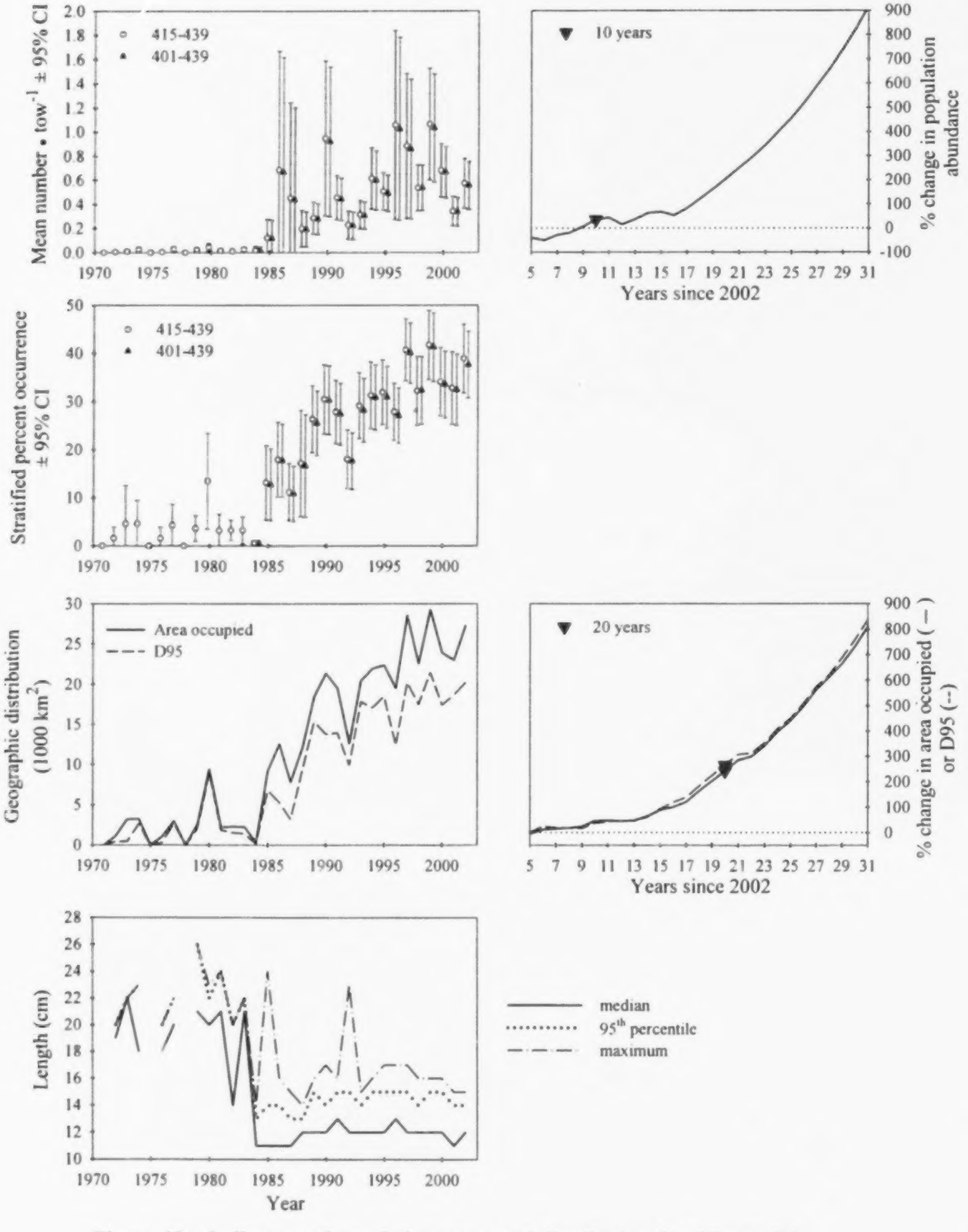

Figure 49a: Indicators of population status and distribution for alligatorfish, *Aspidophoroides monopterygius* (1971-2002).

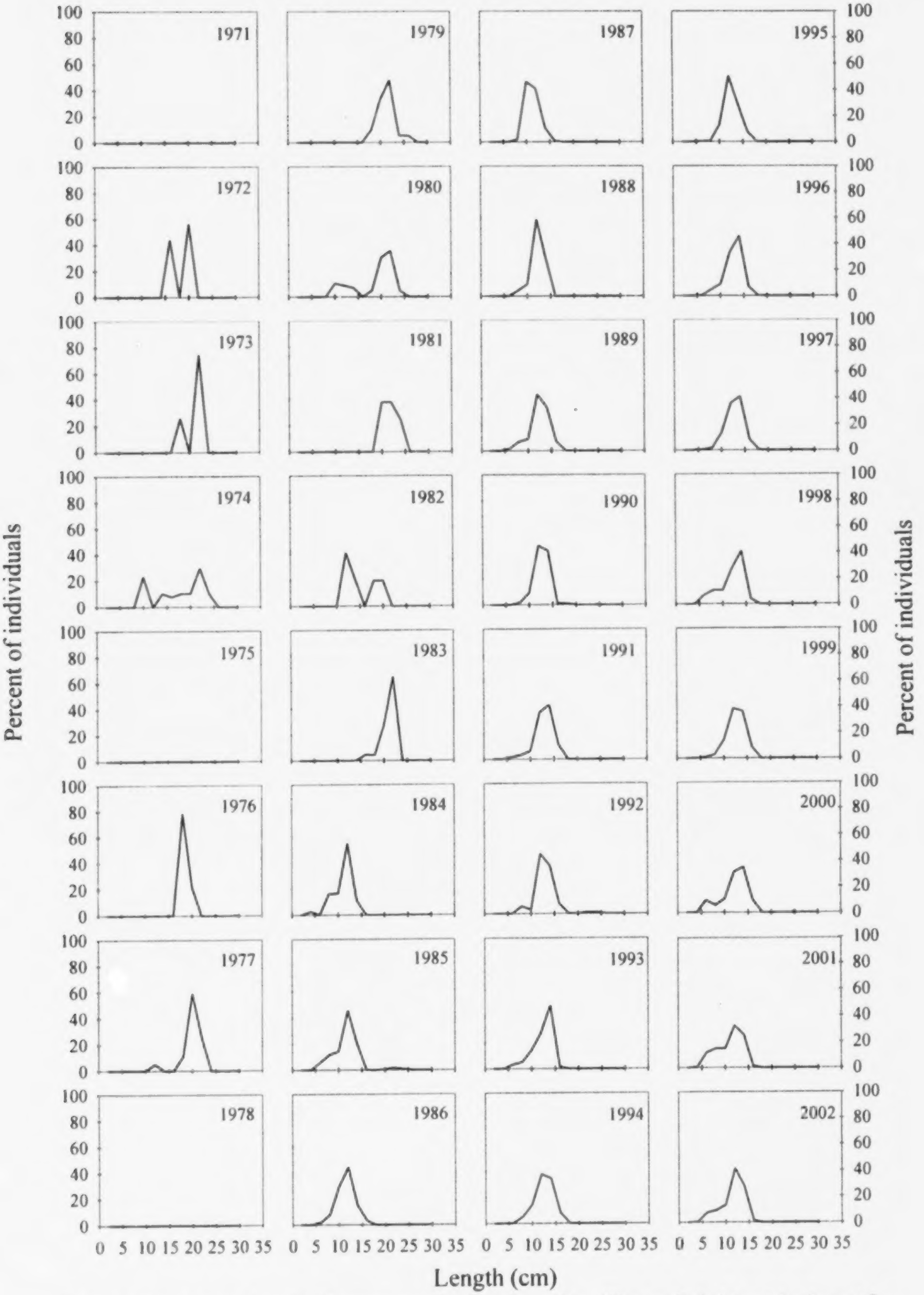

Figure 49b: Yearly length frequency distributions for alligatorfish (*Aspidophoroides monopterygius*).

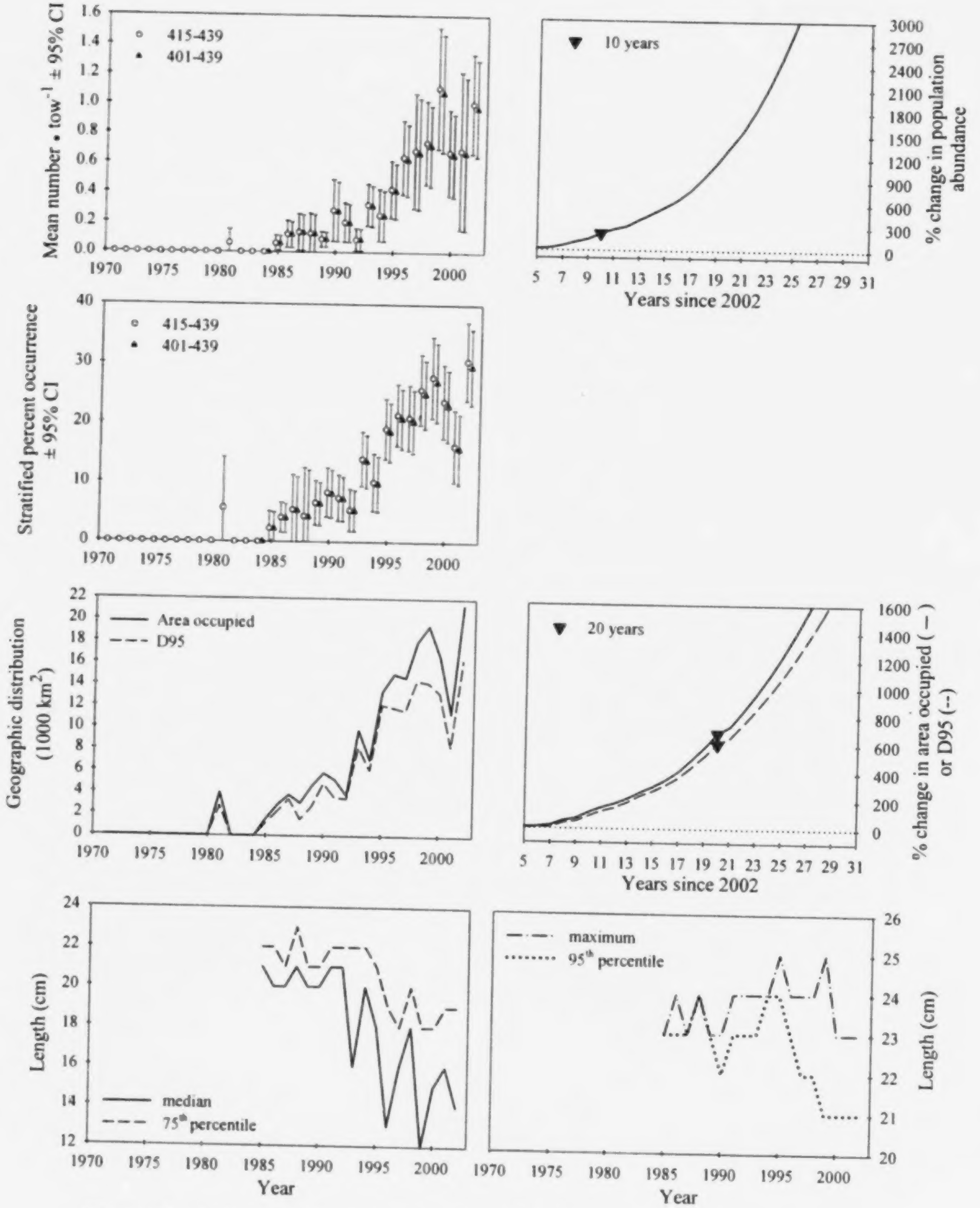

Figure 50a: Indicators of population status and distribution for Atlantic sea poacher, *Leptagonus decagonus* (1971-2002).

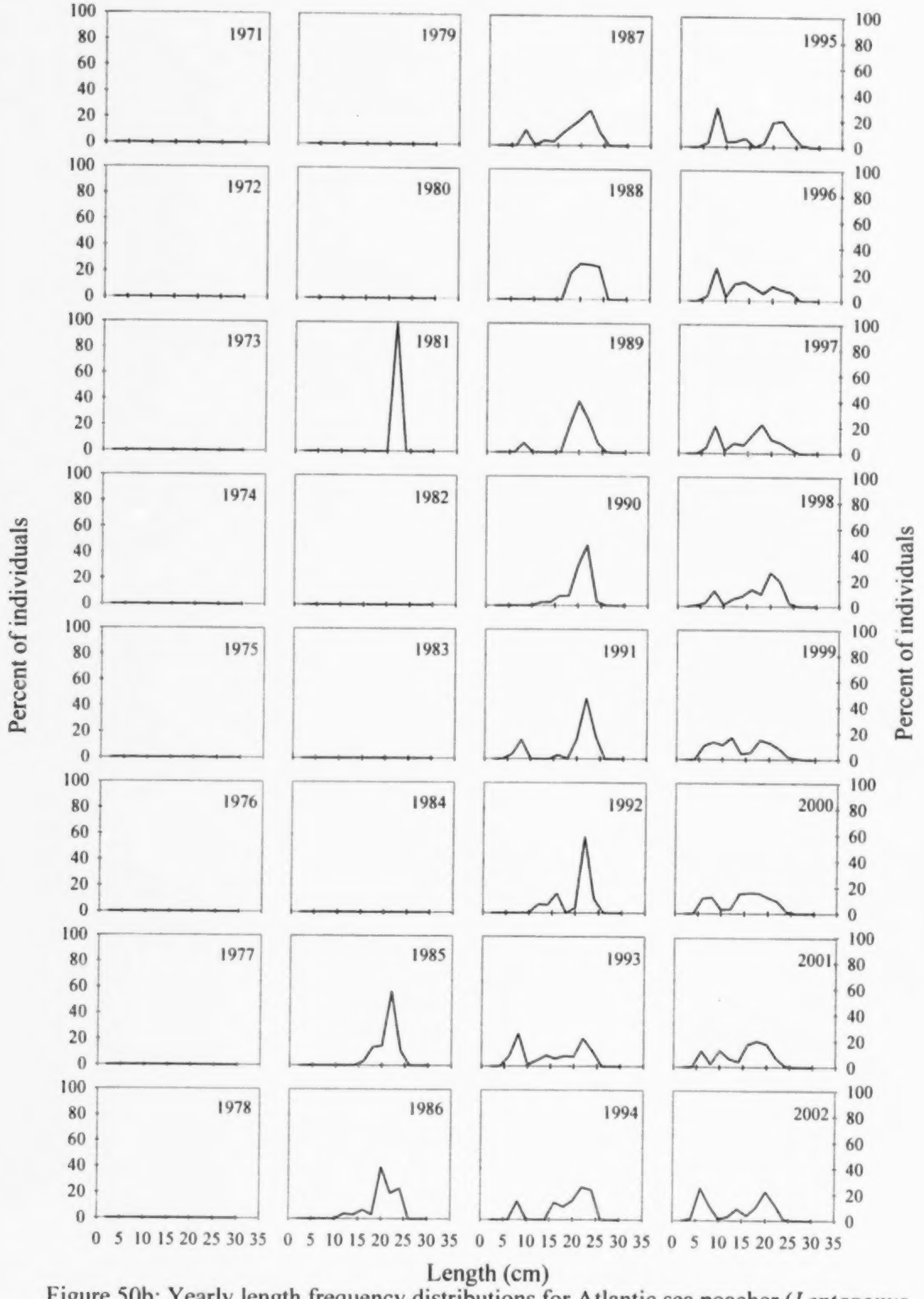

Figure 50b: Yearly length frequency distributions for Atlantic sea poacher (*Leptagonus decagonus*).

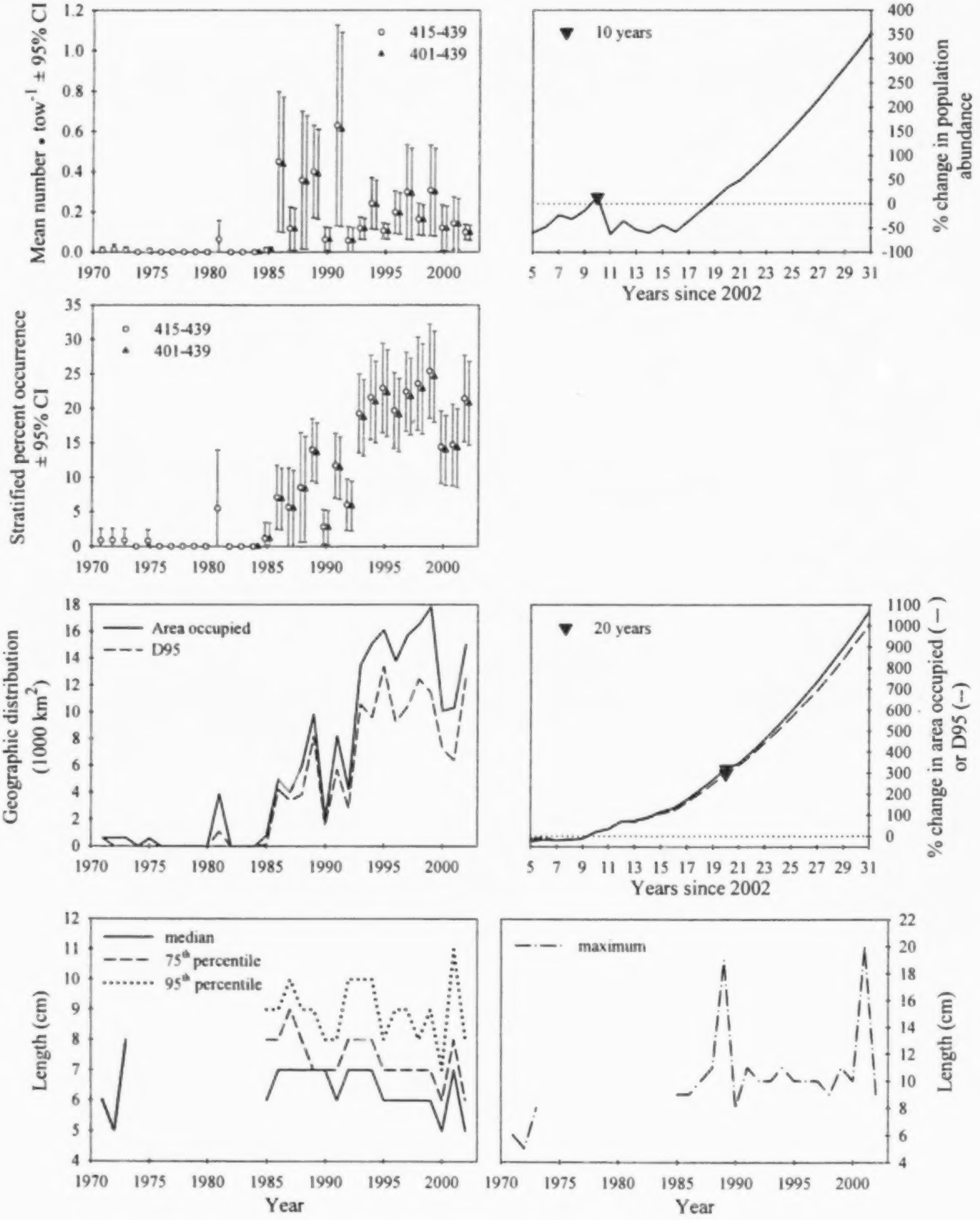

Figure 51a: Indicators of population status and distribution for Arctic hookear sculpin, *Artediellus uncinatus* (1971-2002).

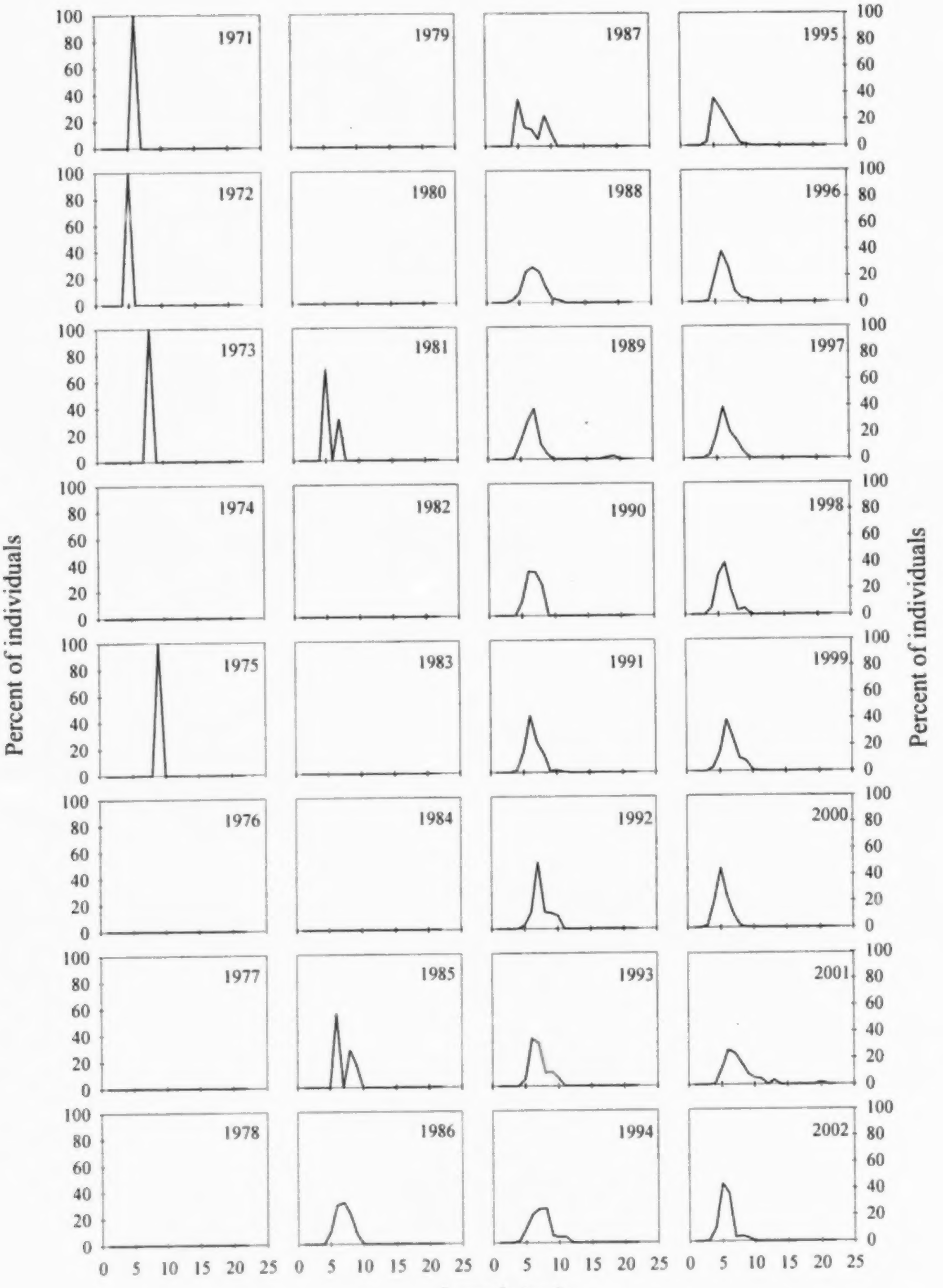

Figure 51b: Yearly length frequency distributions for Arctic hookear sculpin (*Artediellus uncinatus*).

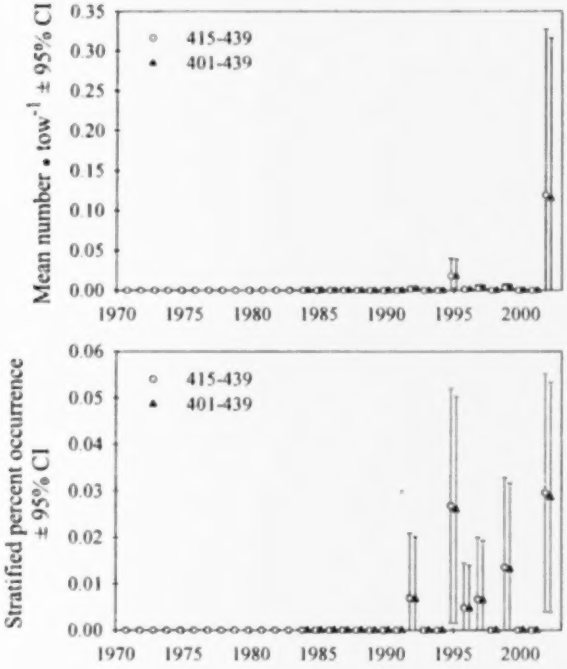

Figure 52a: Indicators of population status and distribution for Arctic staghorn sculpin, *Gymnocanthus tricuspis* (1971-2002).

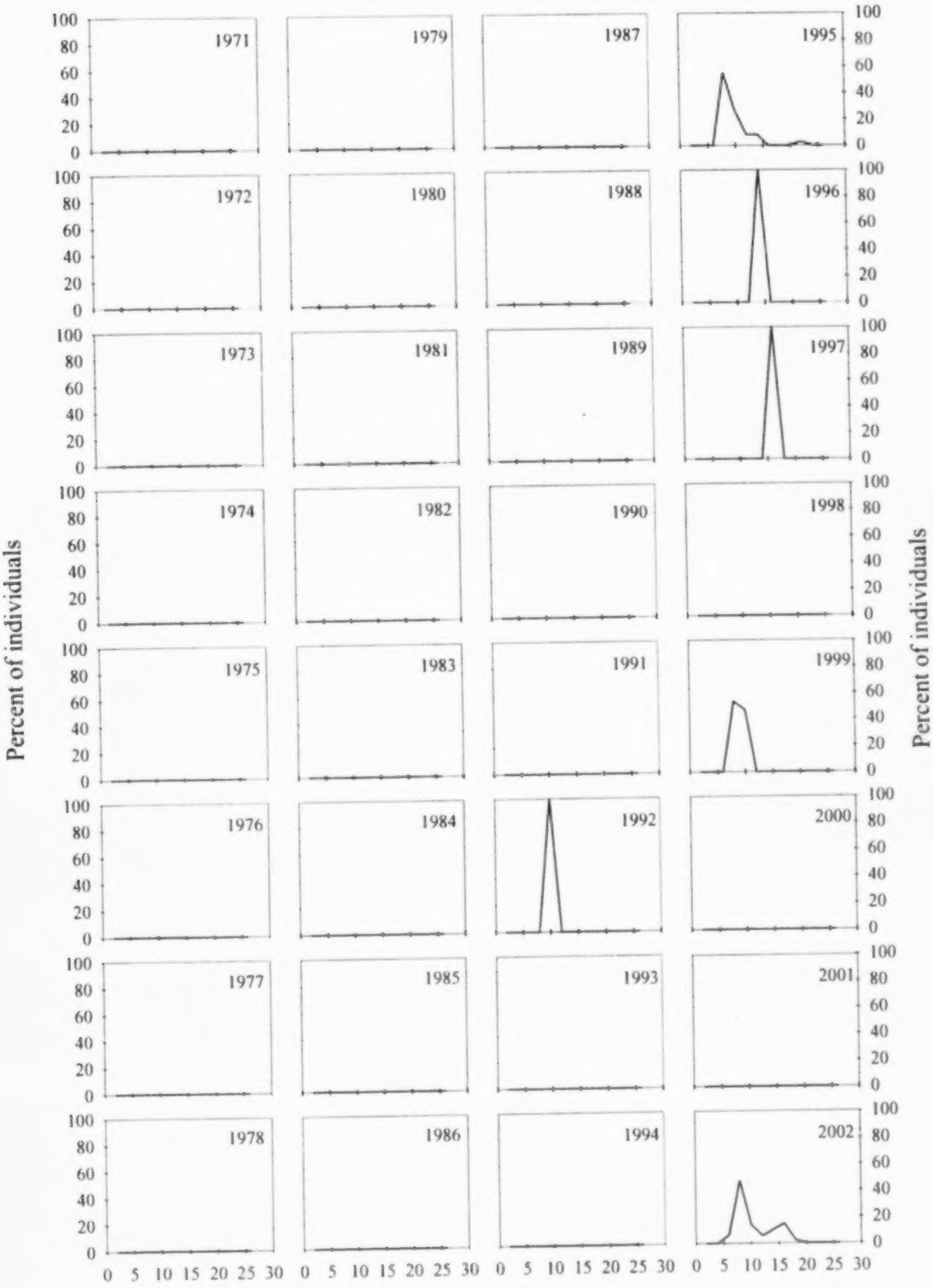

Figure 52b: Yearly length frequency distributions for Arctic staghorn sculpin (*Gymnocanthus tricuspis*).

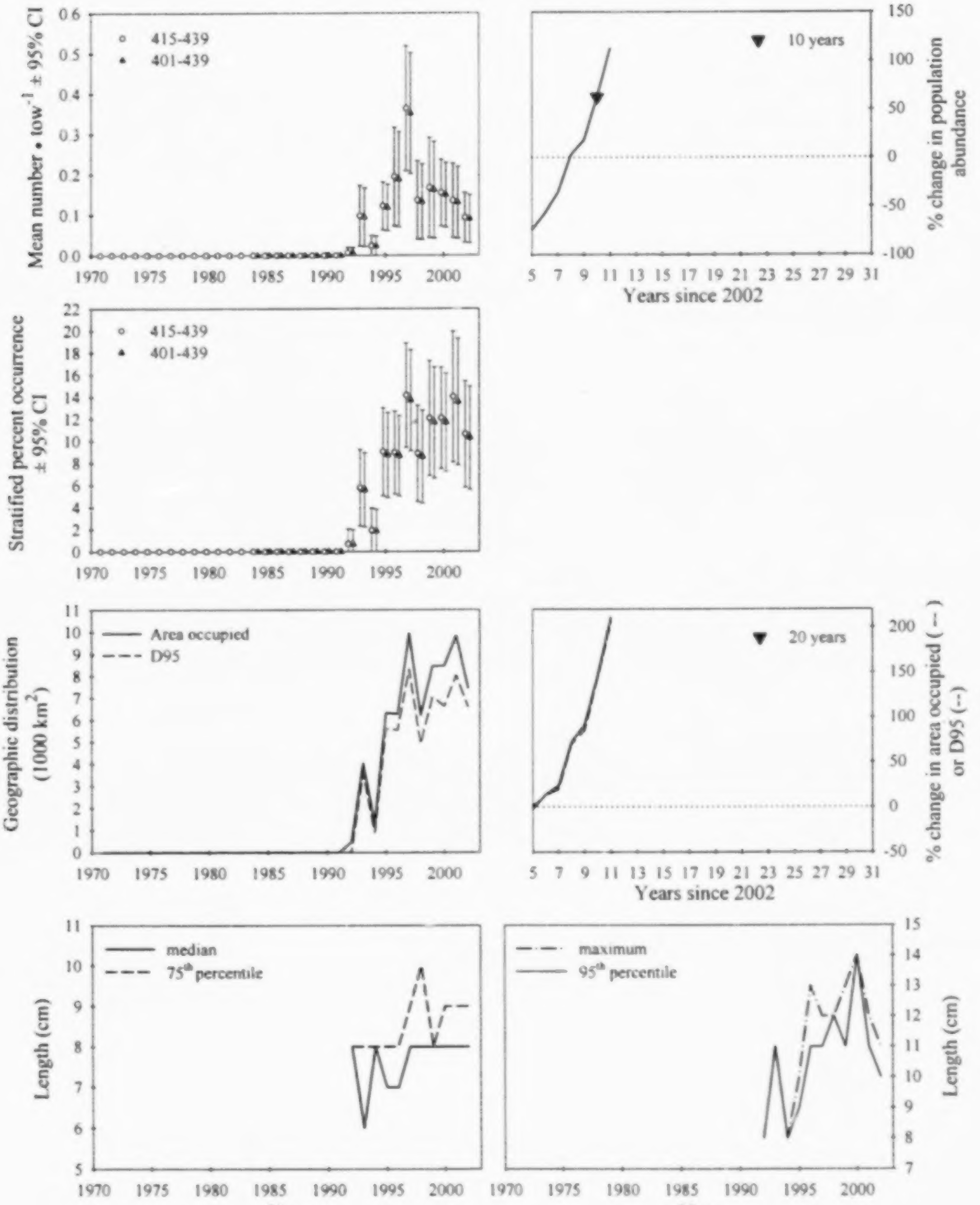

Figure 53a: Indicators of population status and distribution for spatulate sculpin, *Icelus spatula* (1971-2002).

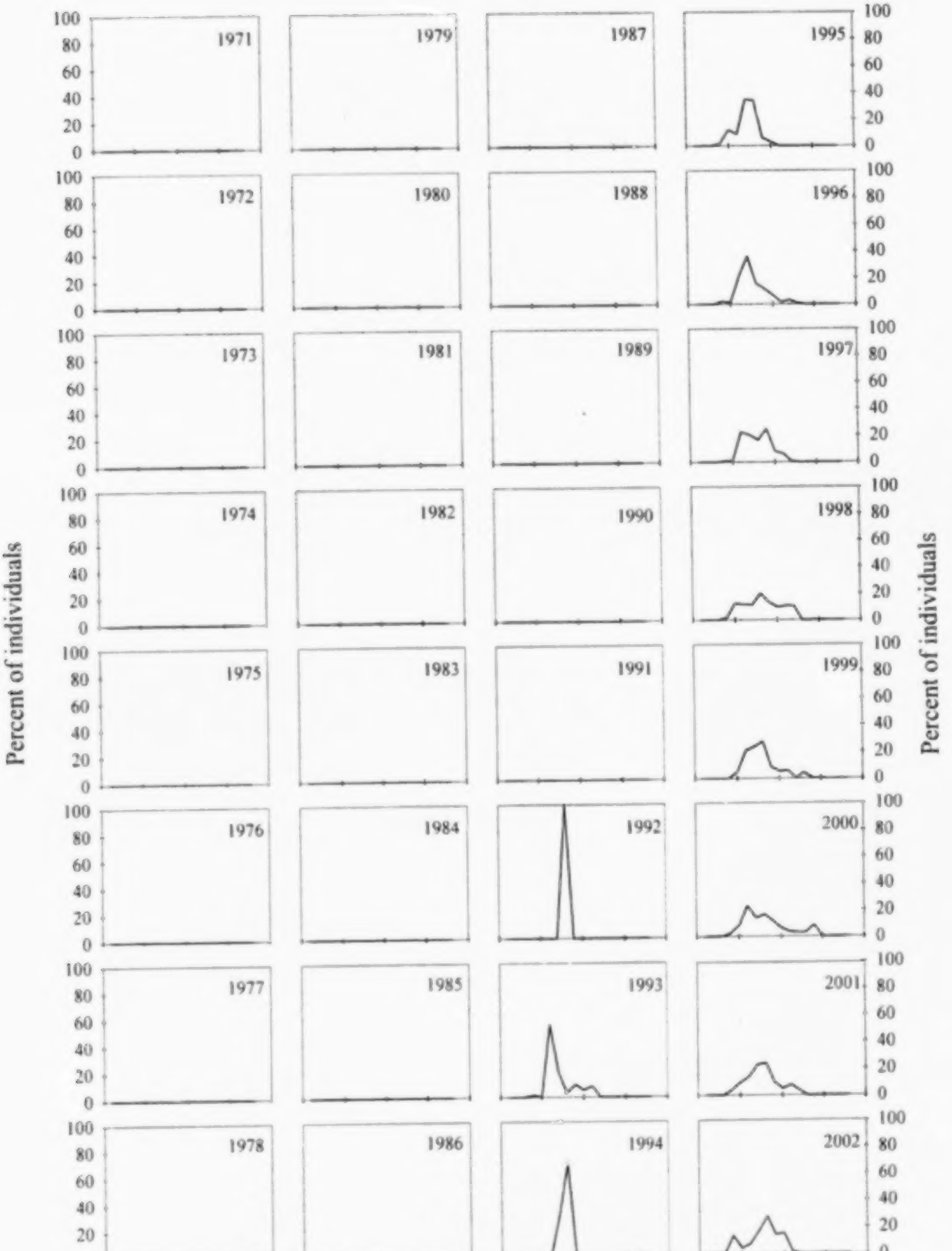

Figure 53b: Yearly length frequency distributions for spatulate sculpin (*Icelus spatula*).

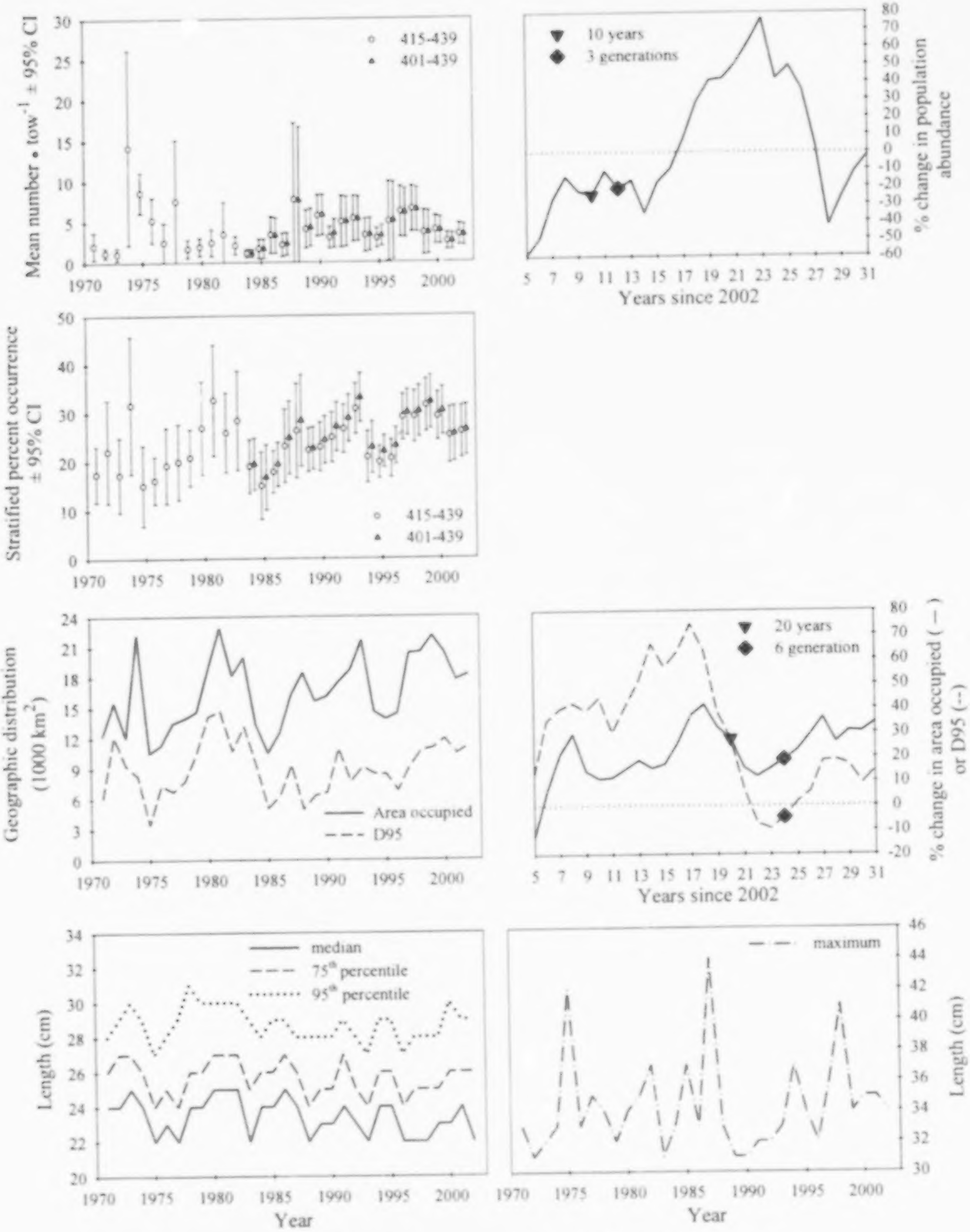

Figure 54a: Indicators of population status and distribution for longhorn sculpin, *Myoxocephalus octodecemspinosus* (1971-2002).

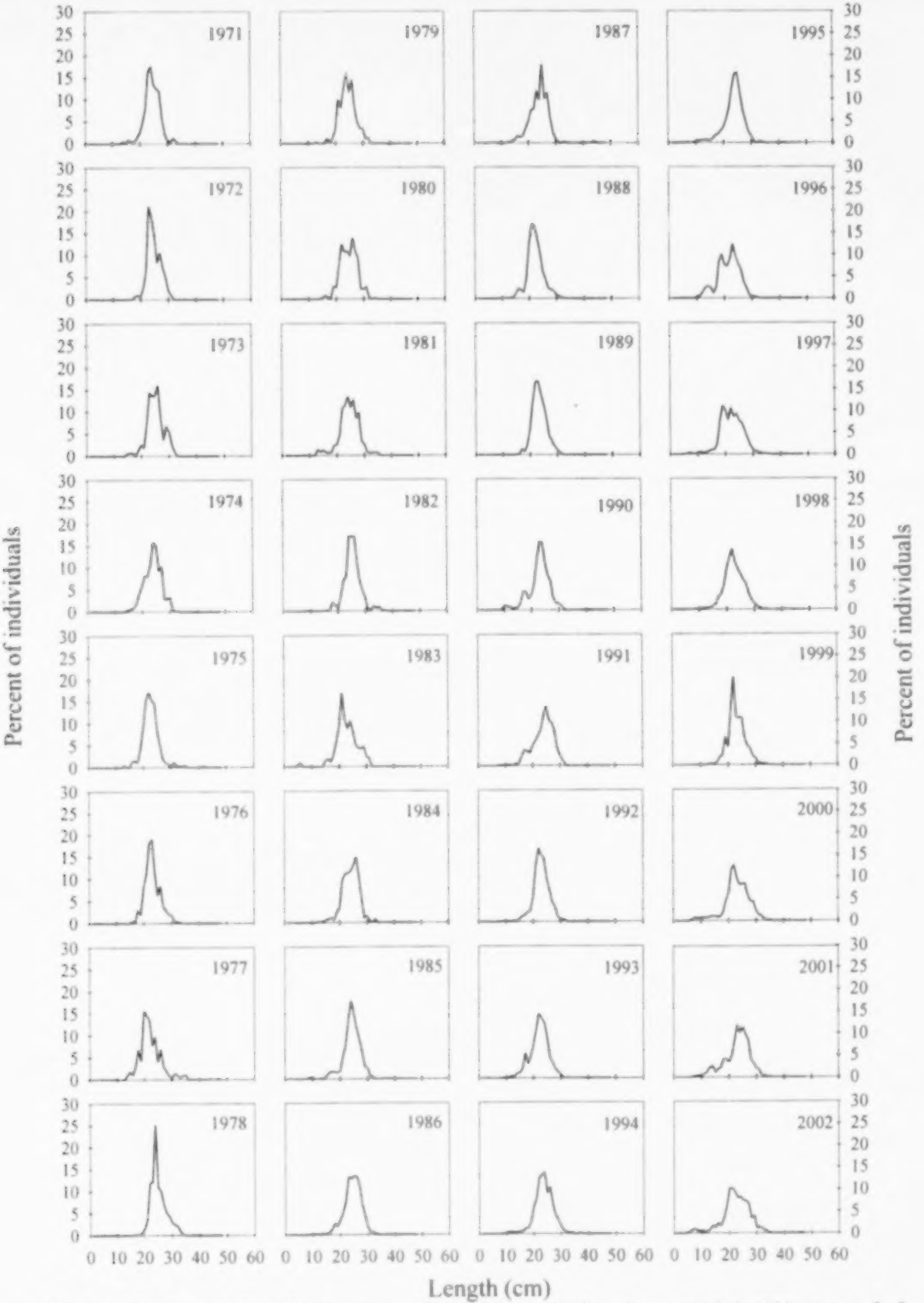

Figure 54b: Yearly length frequency distributions for longhorn sculpin (*Myoxocephalus octodecemspinosus*).

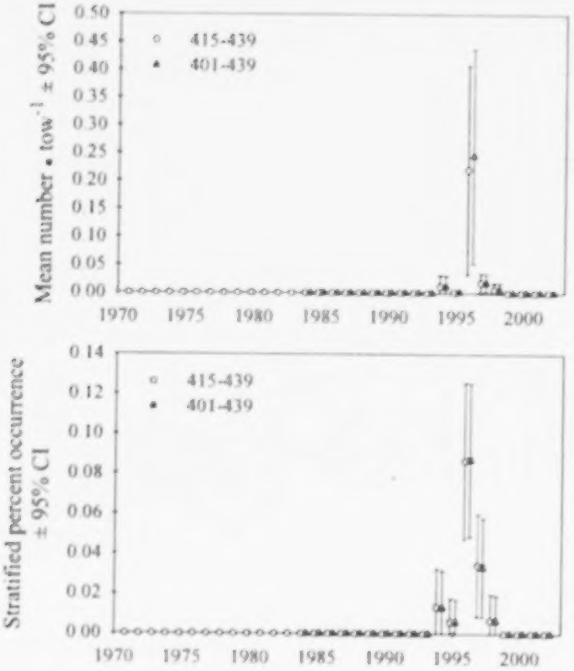

Figure 55a: Indicators of population status and distribution for Arctic sculpin, *Myoxocephalus scorpioides* (1971-2002).

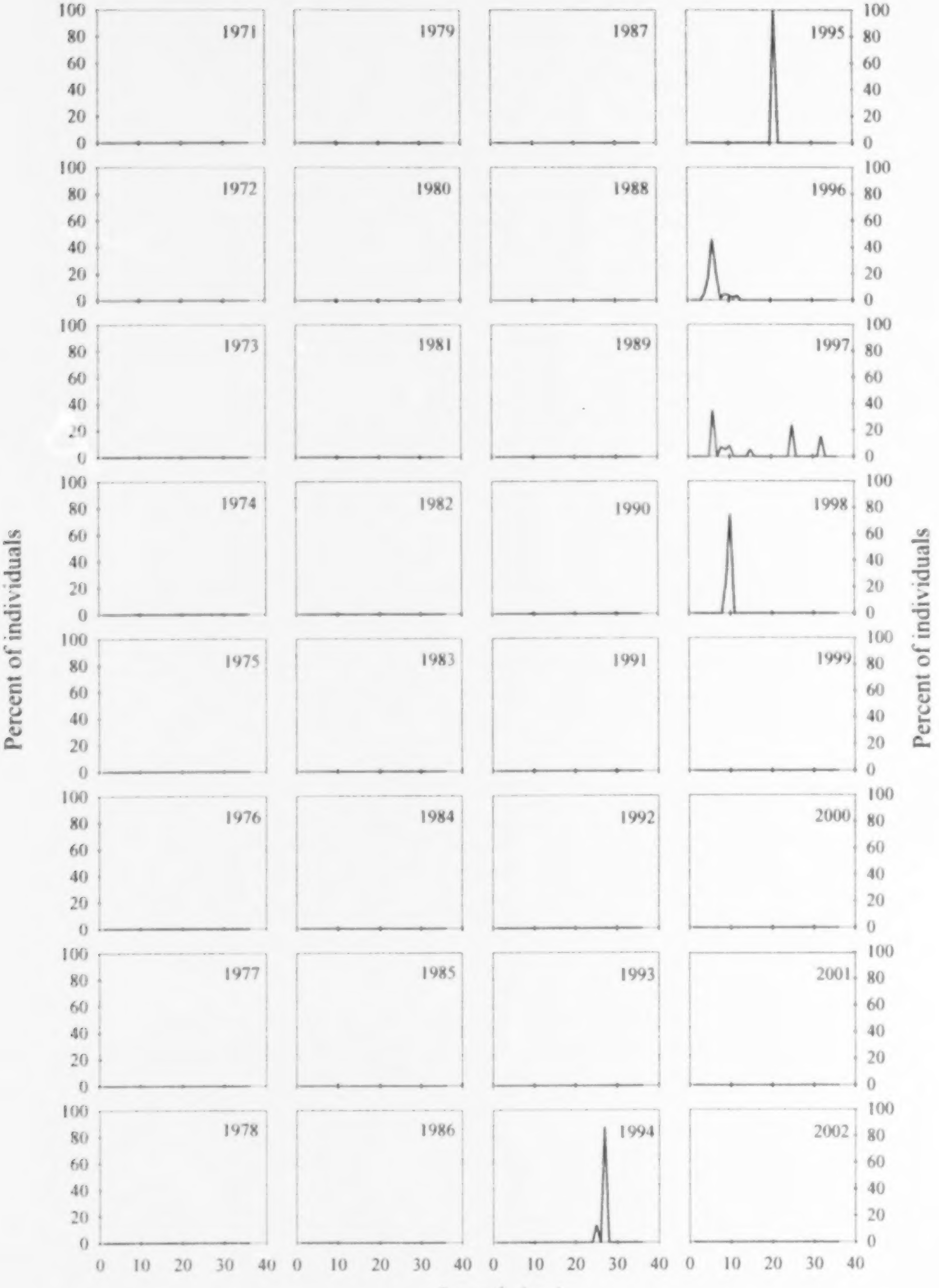

Figure 55b: Yearly length frequency distributions for Arctic sculpin (*Myoxocephalus scorpioides*).

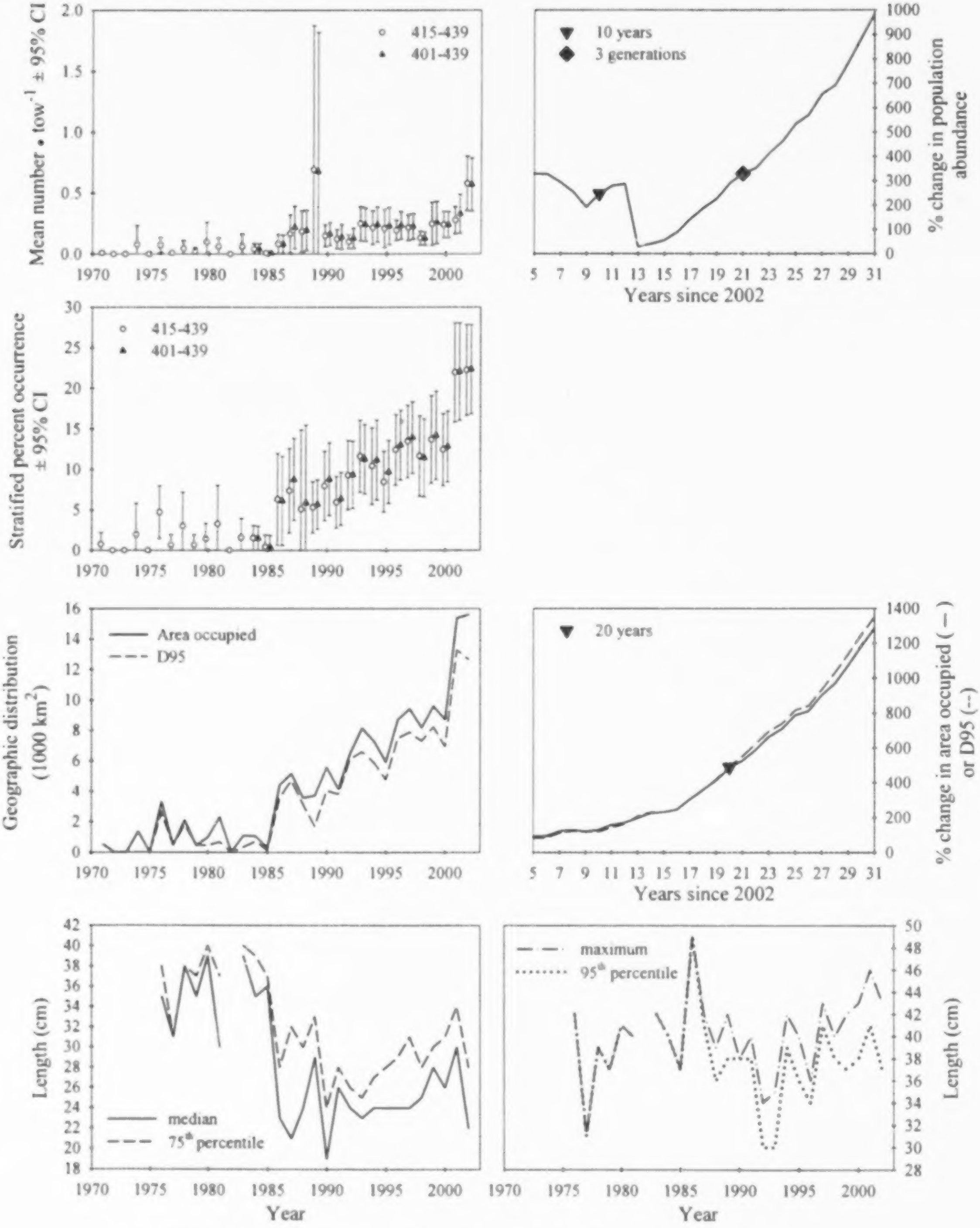

Figure 56a: Indicators of population status and distribution for shorthorn sculpin, *Myoxocephalus scorpius* (1971-2002).

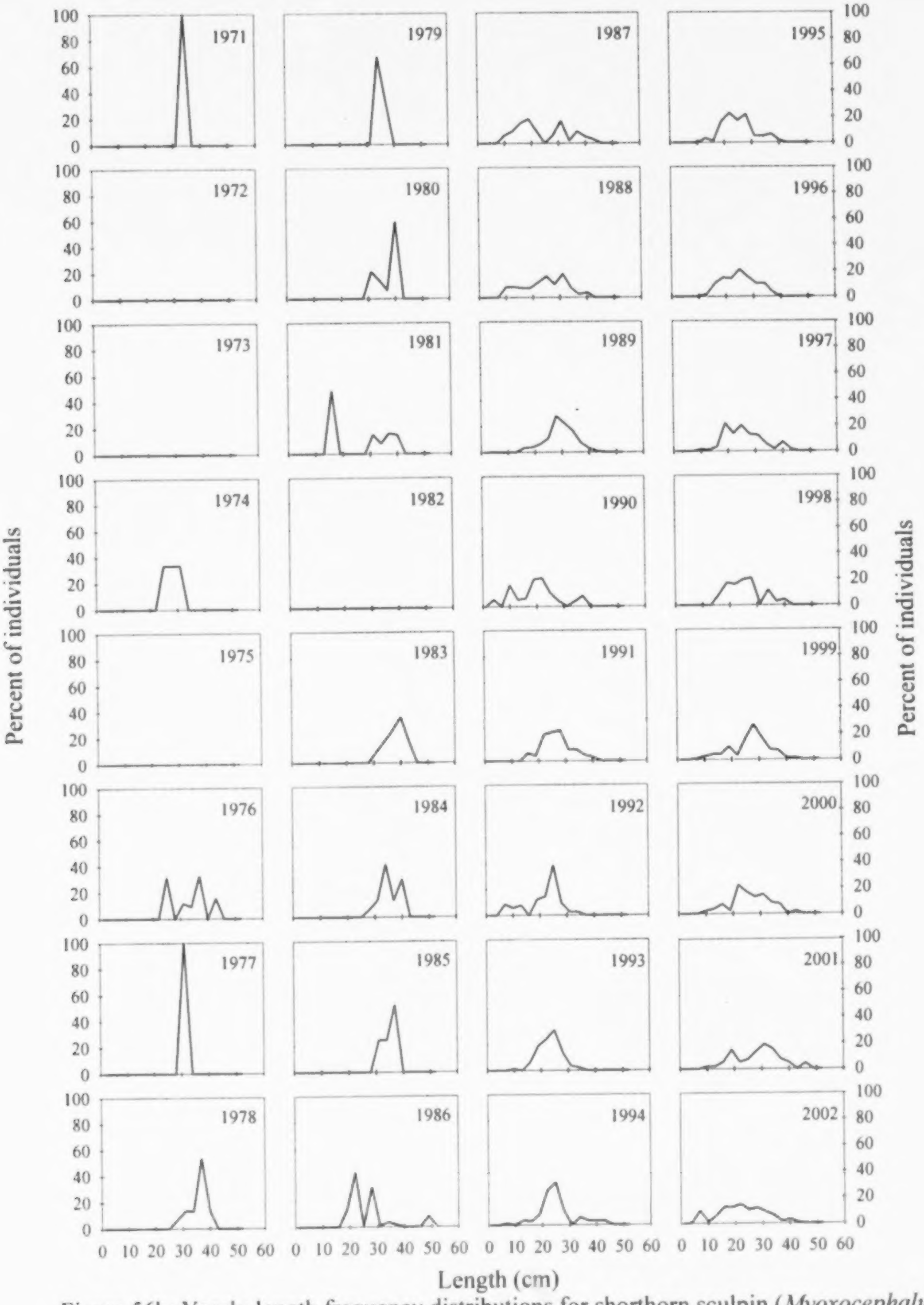

Figure 56b: Yearly length frequency distributions for shorthorn sculpin (*Myoxocephalus scorpius*).

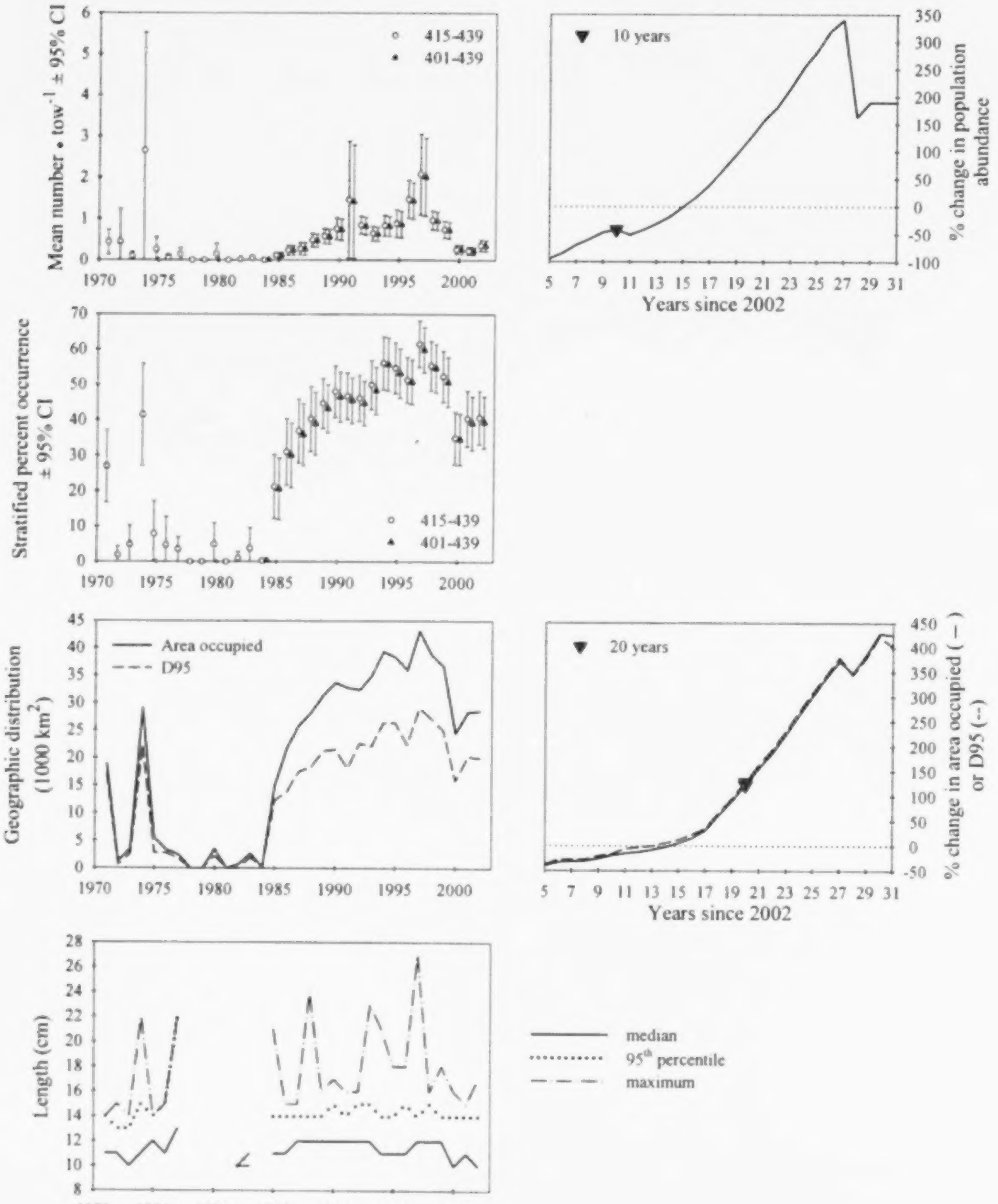

Figure 57a: Indicators of population status and distribution for moustache (mailed) sculpin, *Triglops murrayi* (1971-2002).

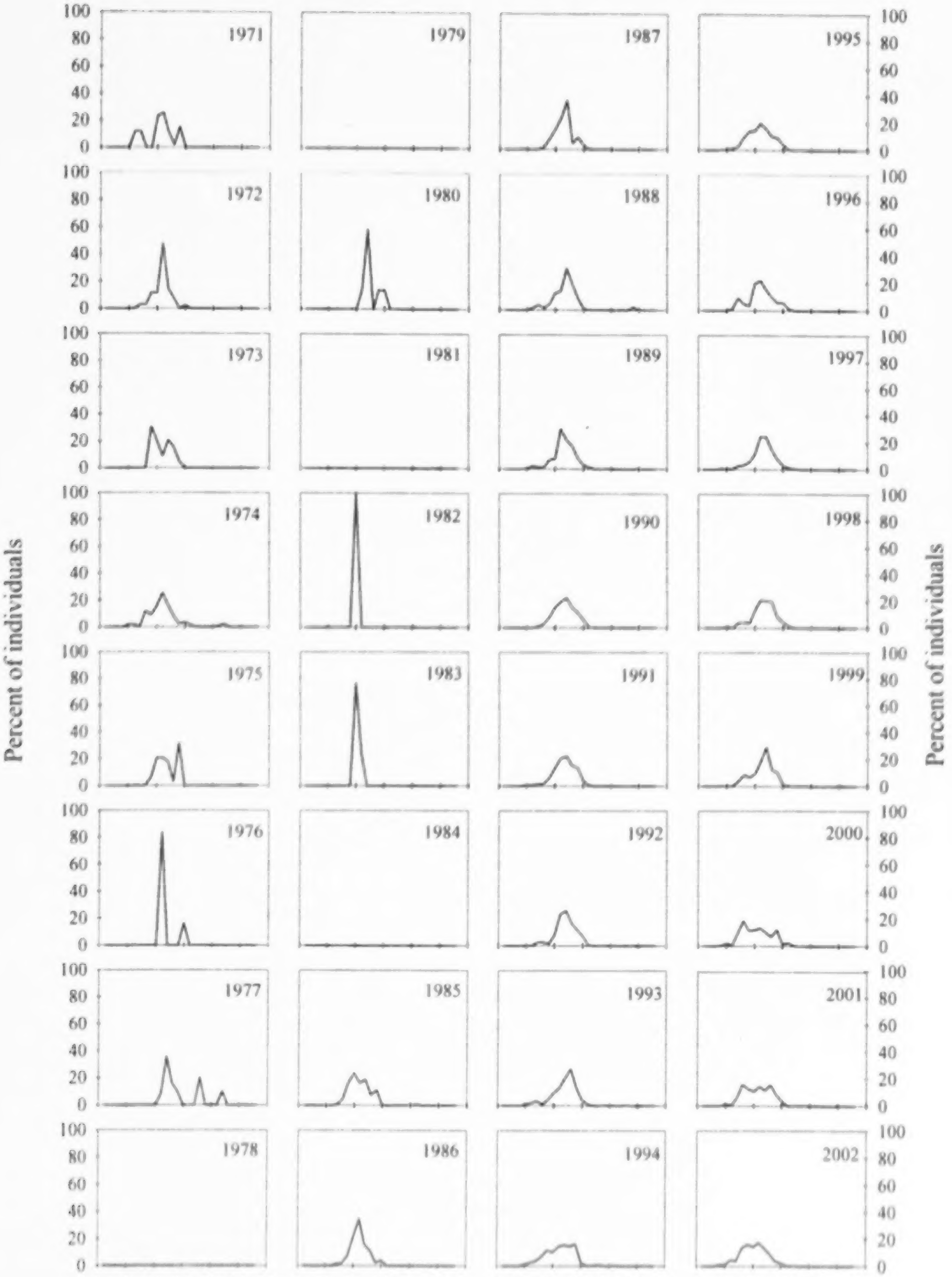

Figure 57b: Yearly length frequency distributions for moustache (mailed) sculpin (*Triglops murrayi*).

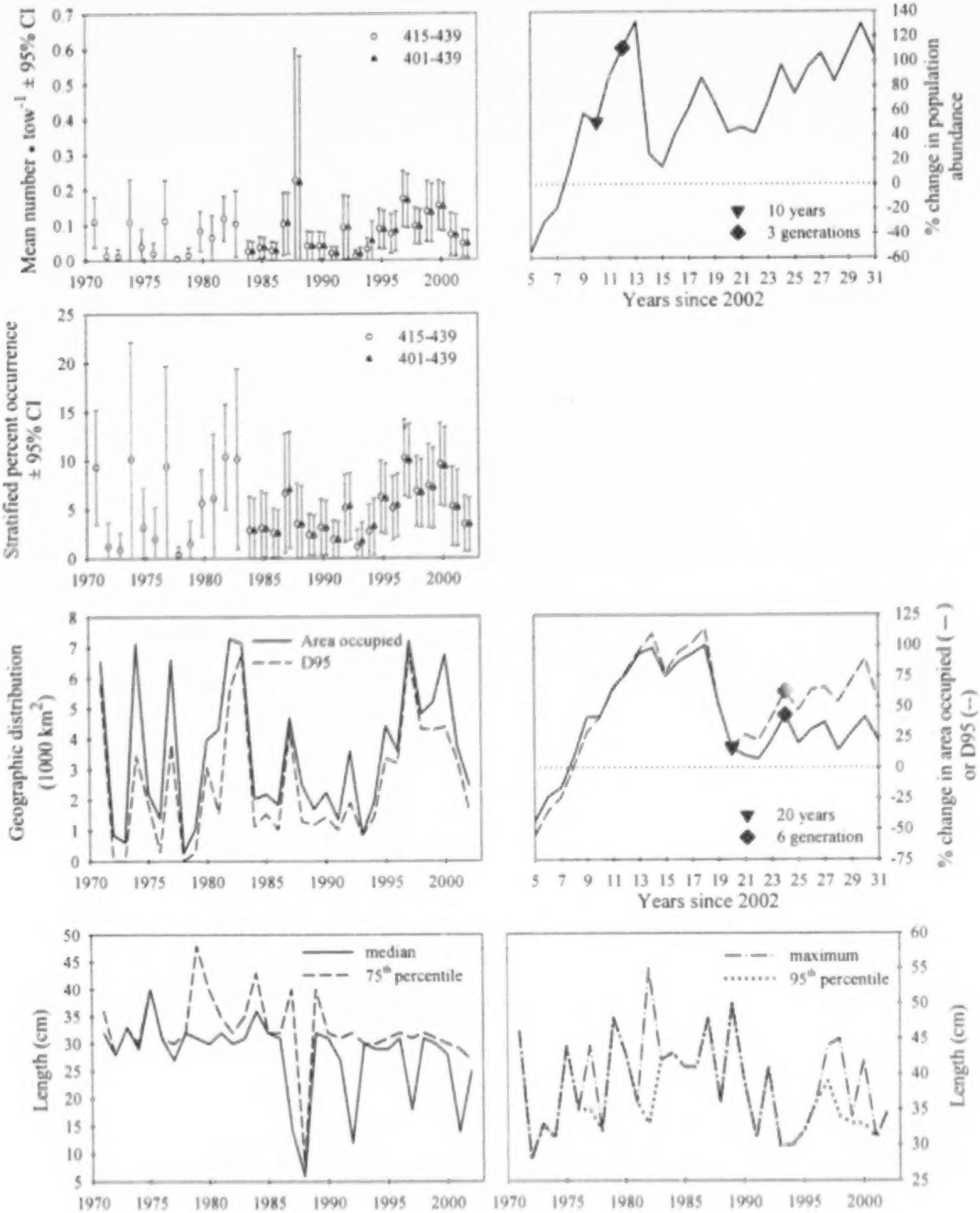

Figure 58a: Indicators of population status and distribution for lumpfish, *Cyclopterus lumpus* (1971-2002).

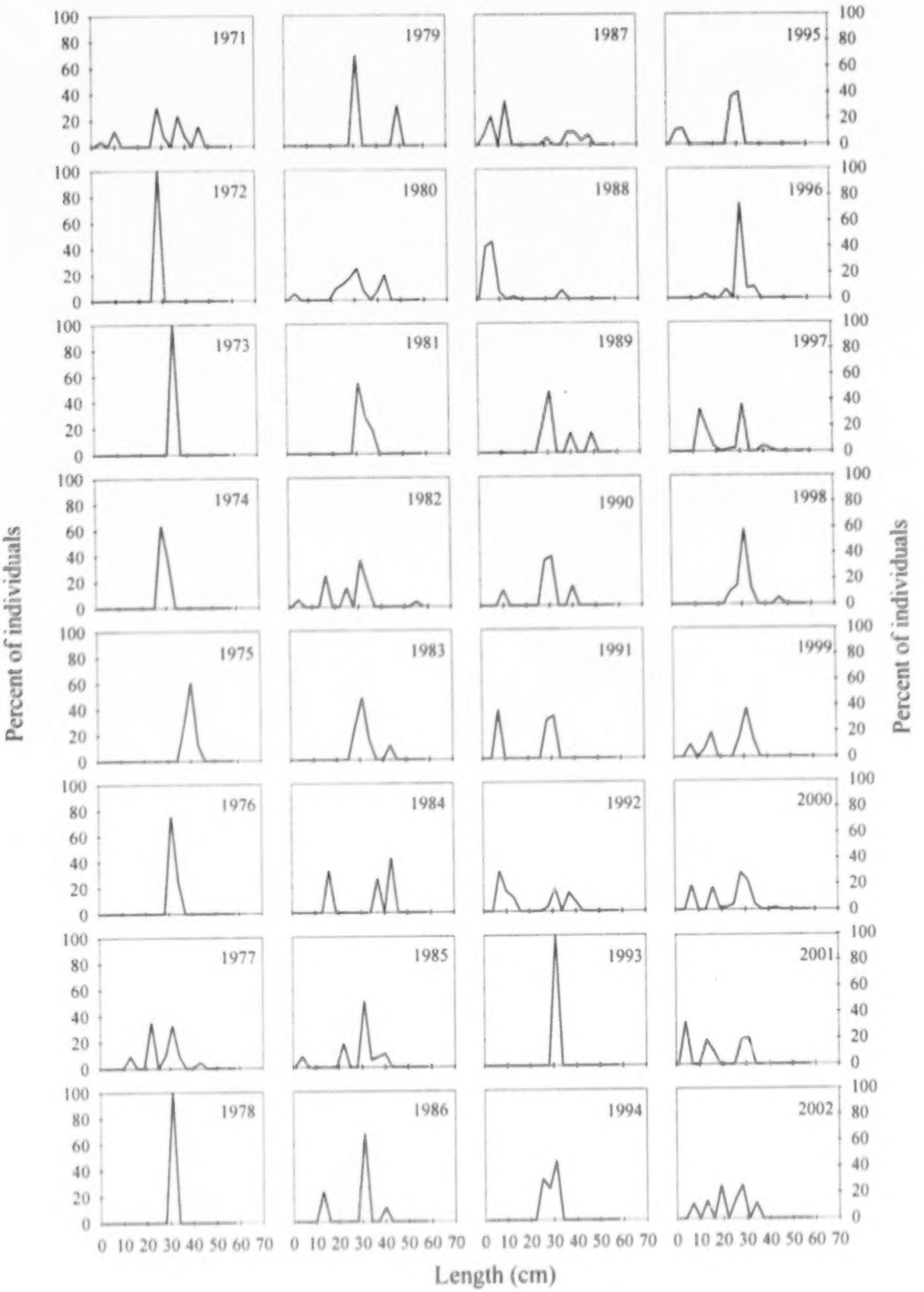

Figure 58b: Yearly length frequency distributions for lumpfish (*Cyclopterus lumpus*).

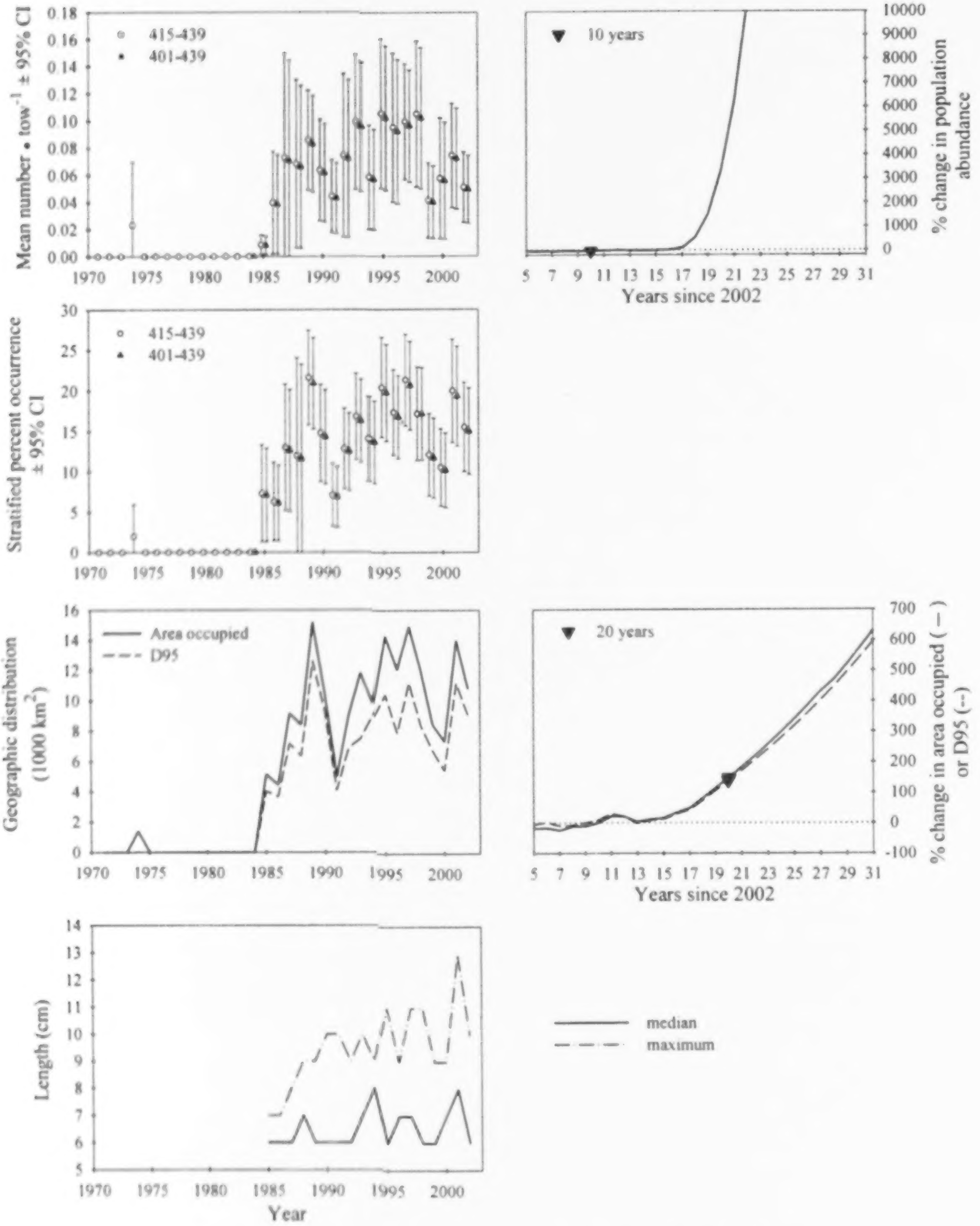

Figure 59a: Indicators of population status and distribution for Atlantic spiny lumpsucker, *Eumicrotremus spinosus* (1971-2002).

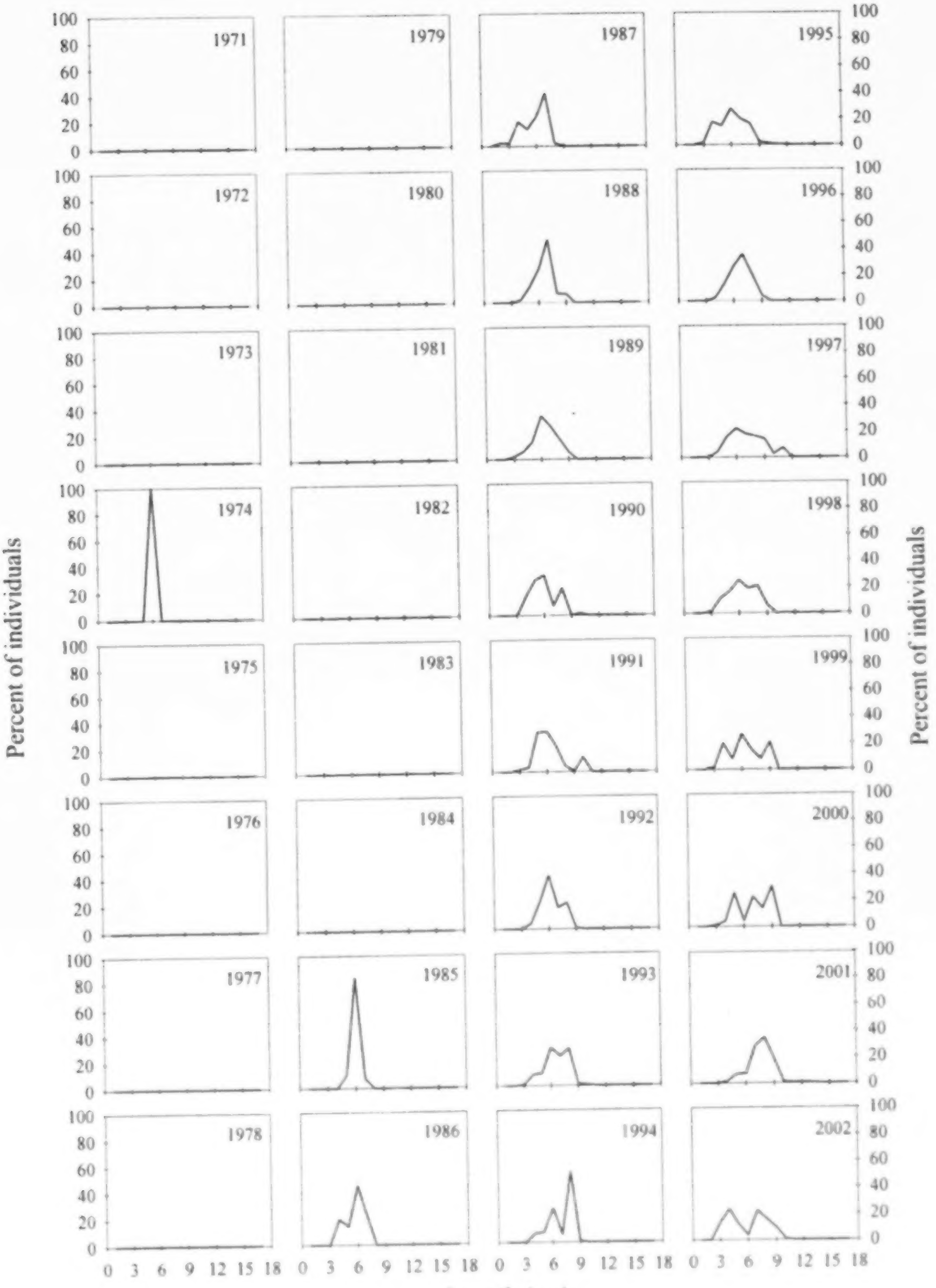

Figure 59b: Yearly length frequency distributions for Atlantic spiny lumpsucker (*Eumicrotremus spinosus*).

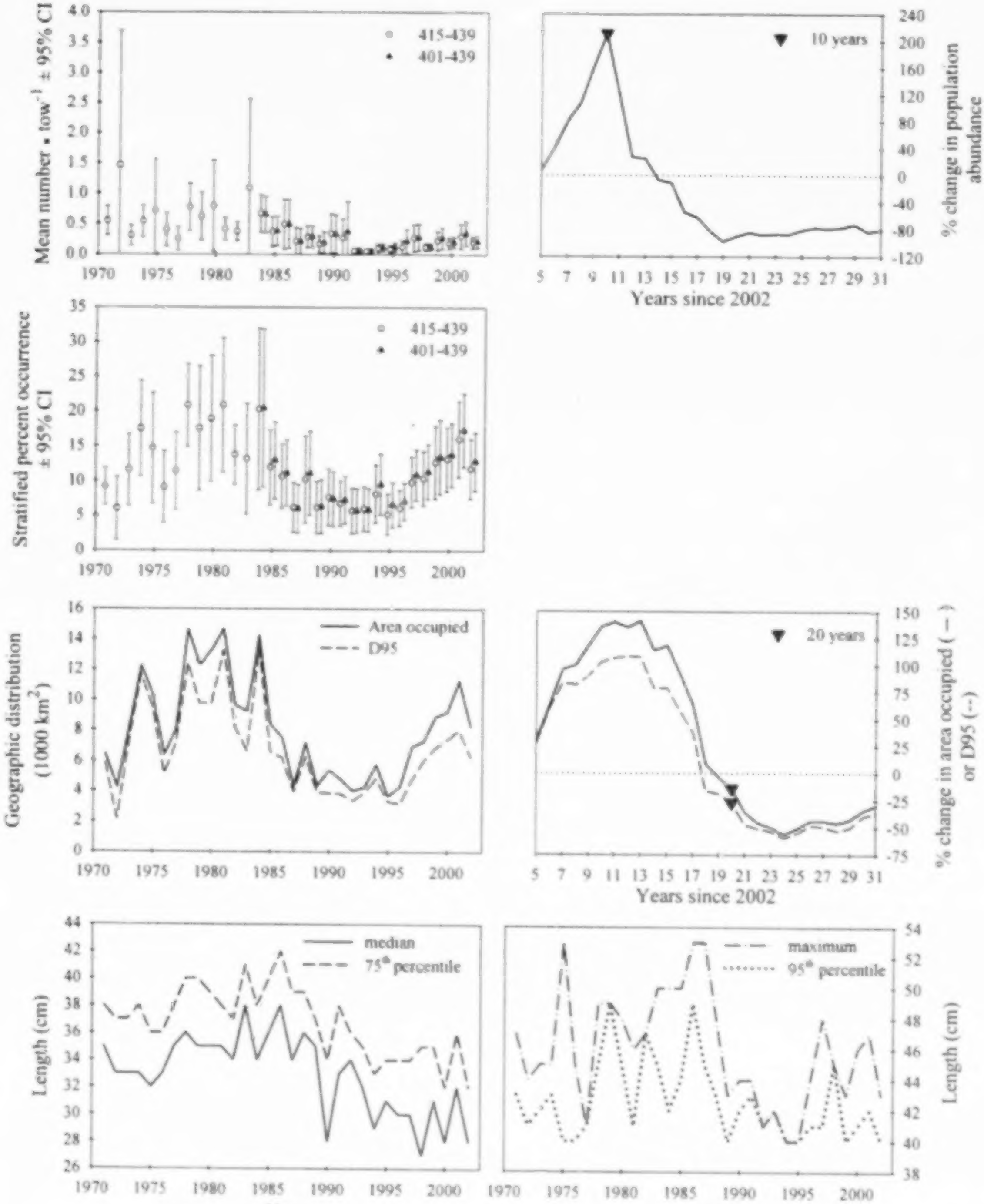

Figure 60a: Indicators of population status and distribution for sea raven, *Hemitripterus americanus* (1971-2002).

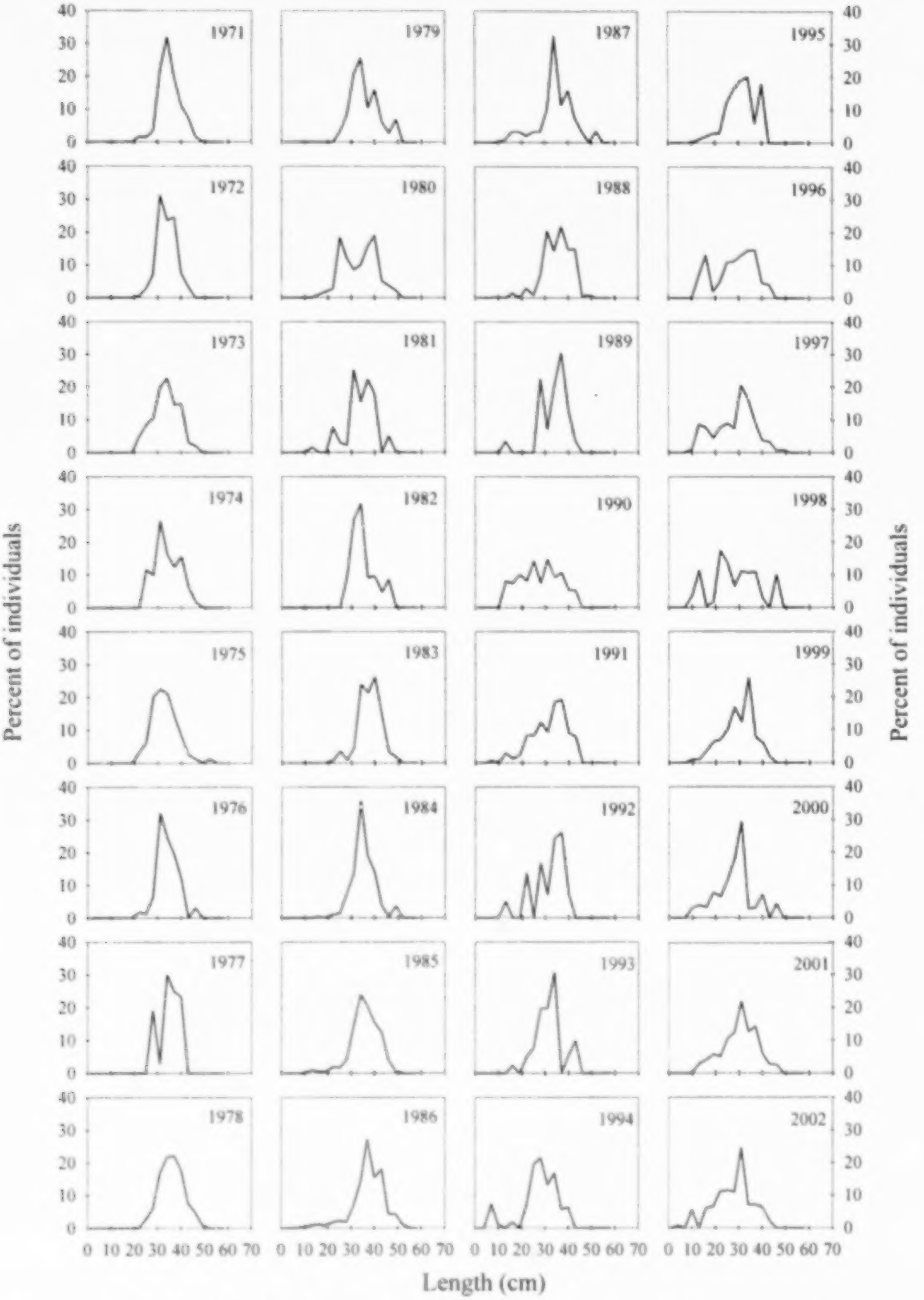

Figure 60b: Yearly length frequency distributions for sea raven (*Hemitripterus americanus*).

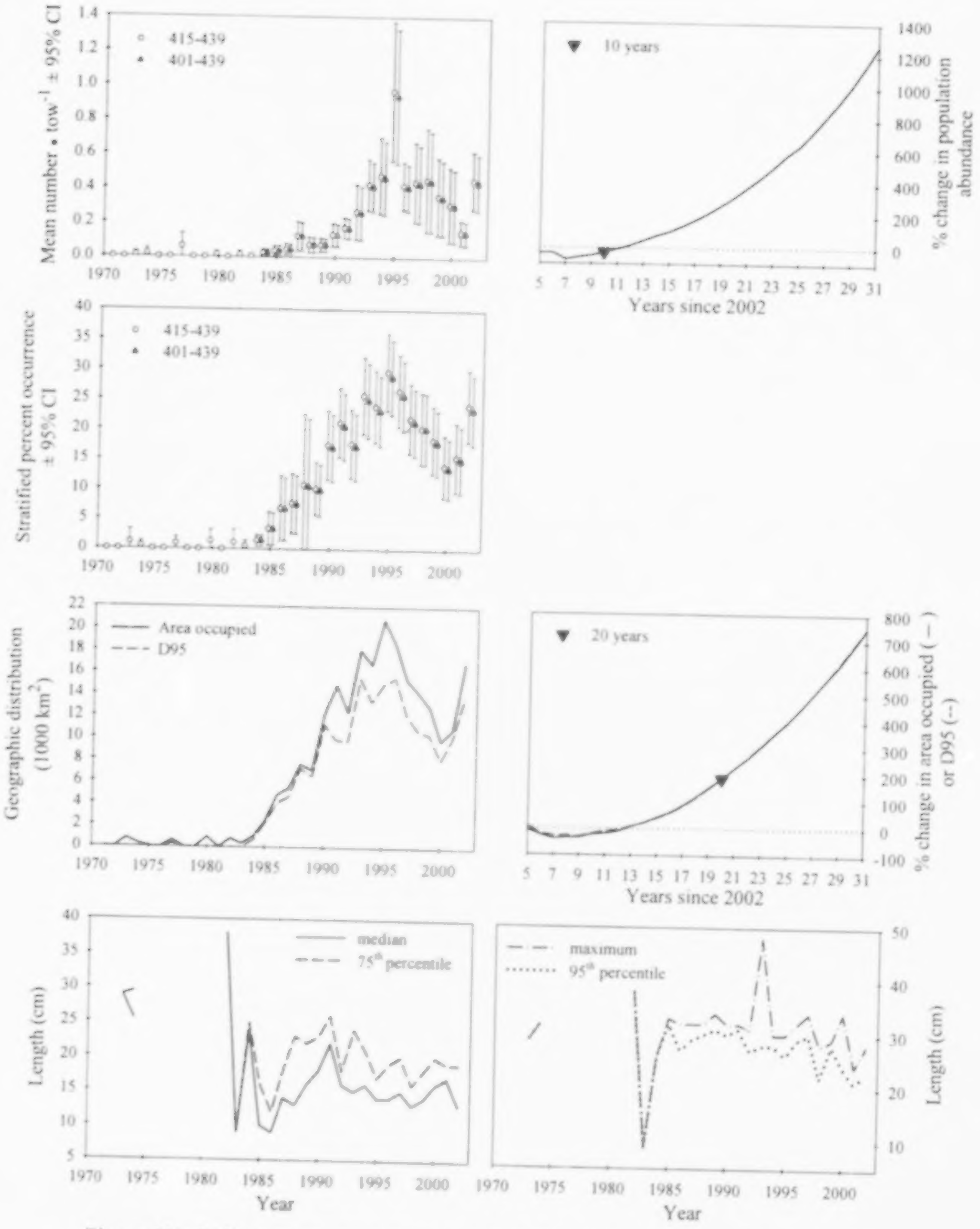

Figure 61a: Indicators of population status and distribution for seasnails (unseparated), *Liparis* spp. (1971-2002).

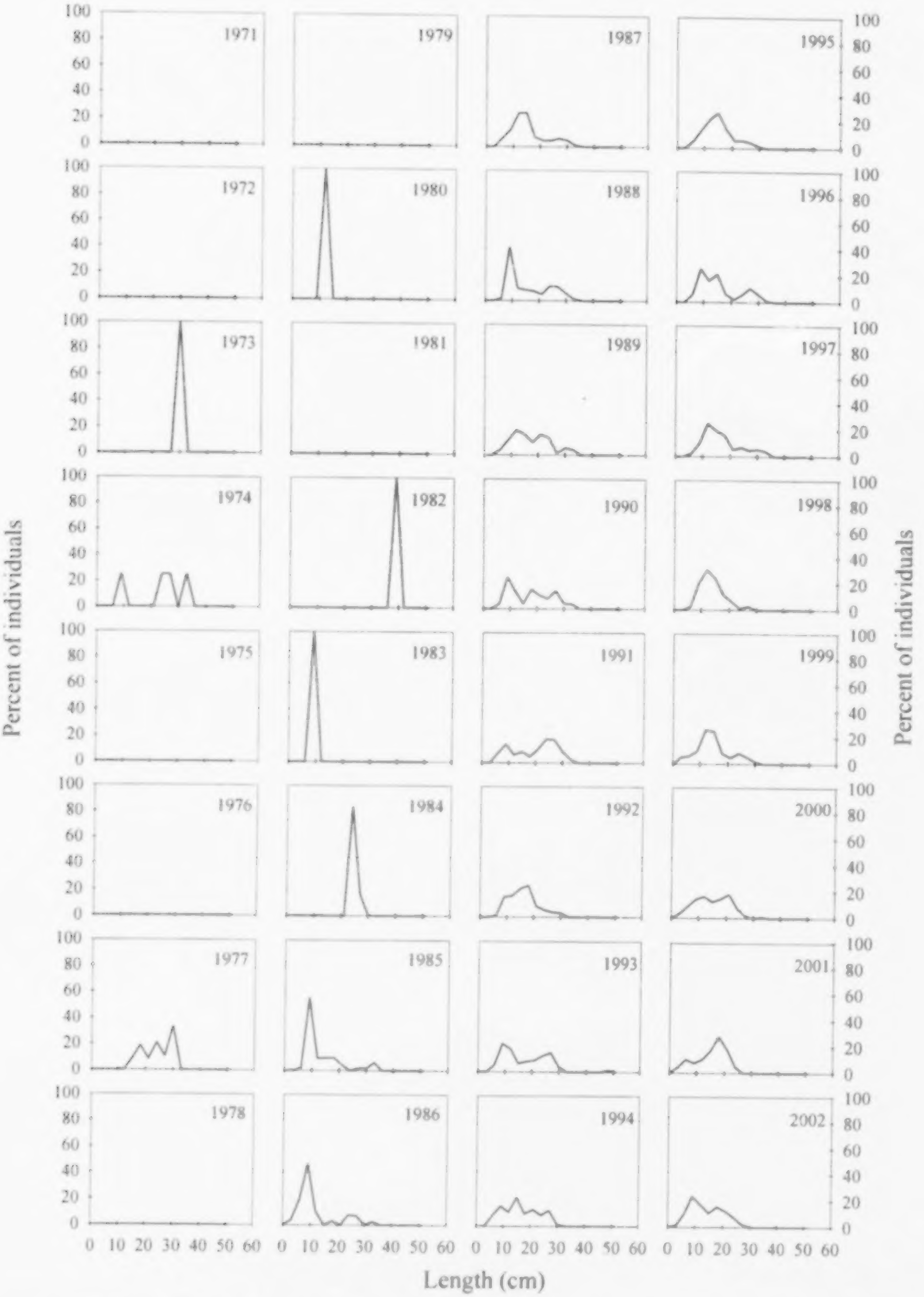

Figure 61b: Yearly length frequency distributions for unseparated seasnails (*Liparis* spp.).

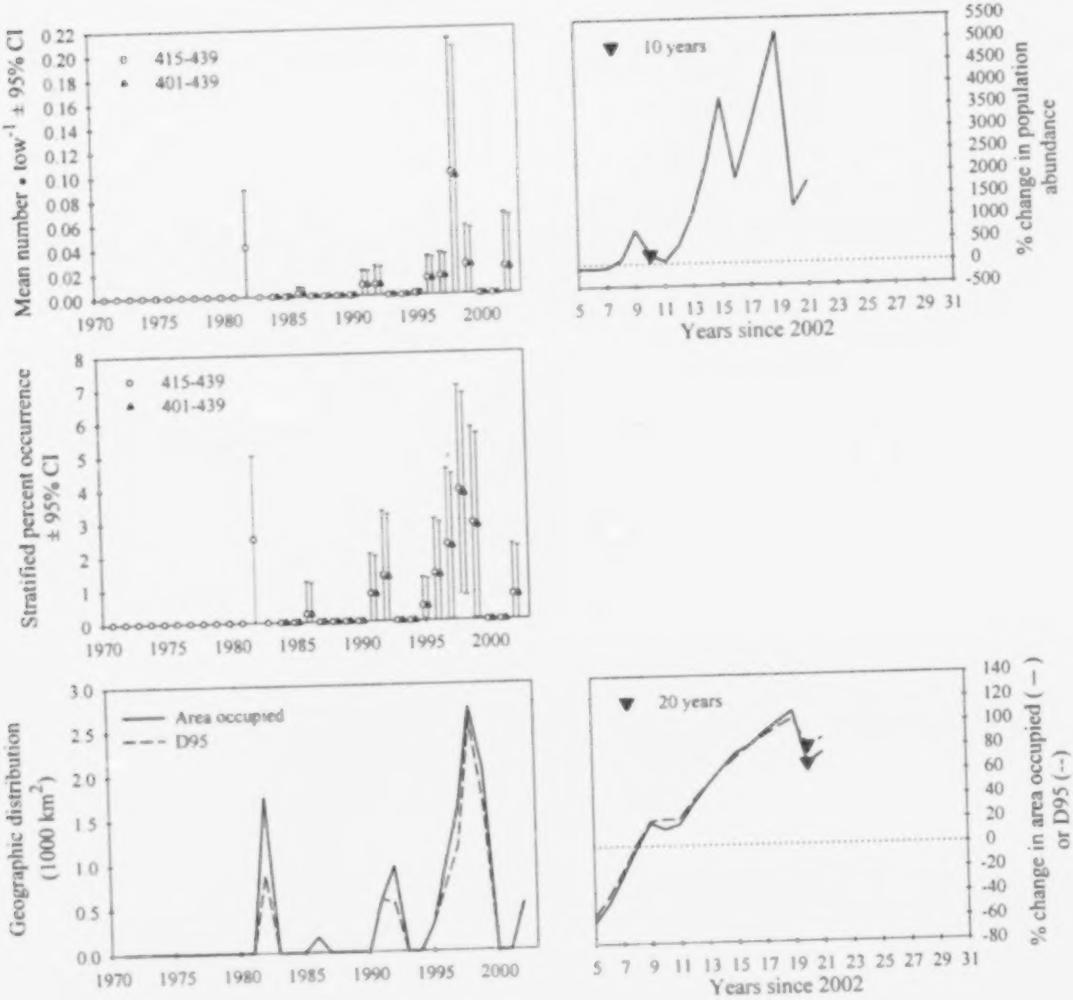

Figure 62a: Indicators of population status and distribution for polar sculpin, *Cottunculus microps* (1971-2002).

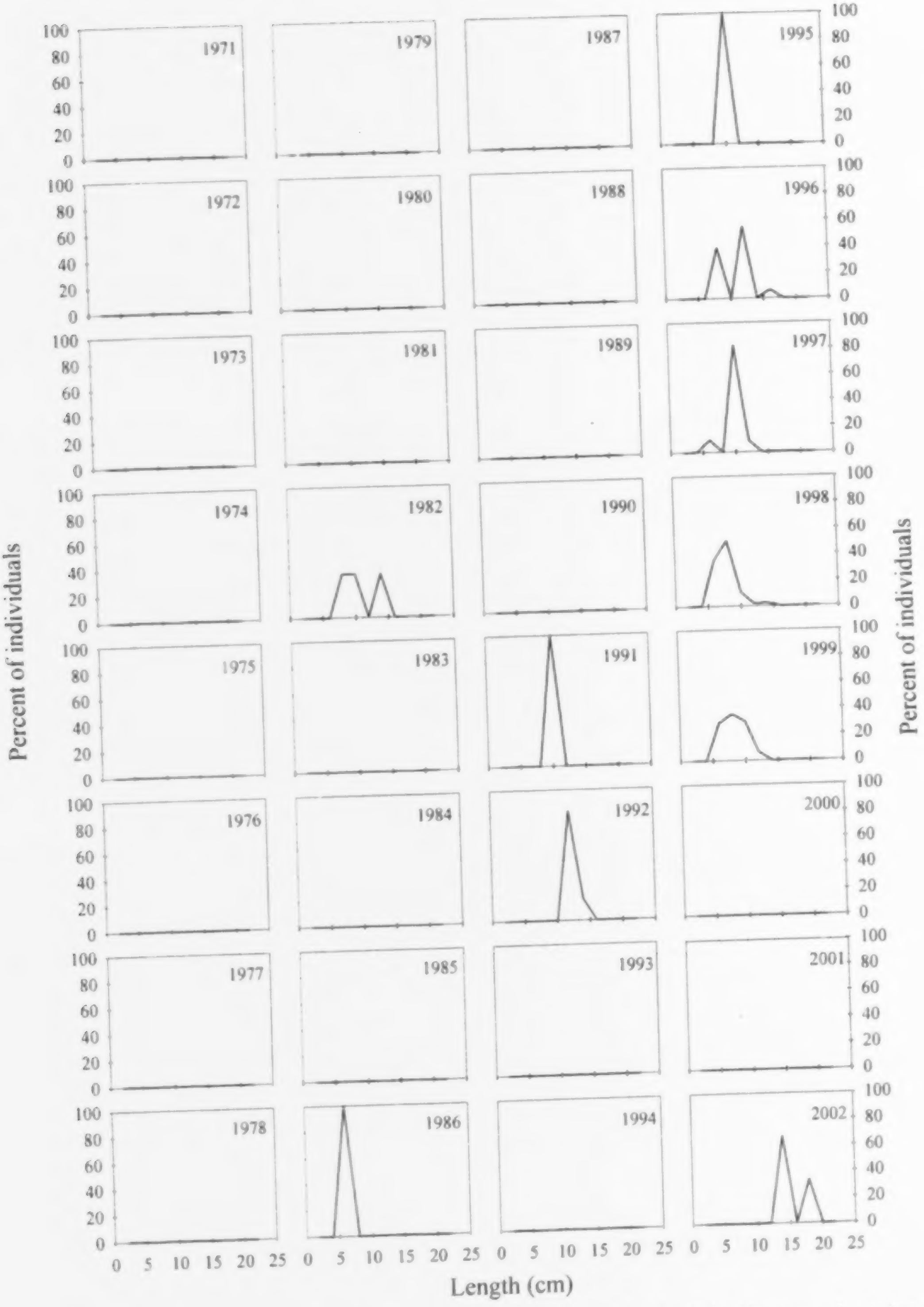

Figure 62b: Yearly length frequency distributions for polar sculpin (*Cottunculus microps*).

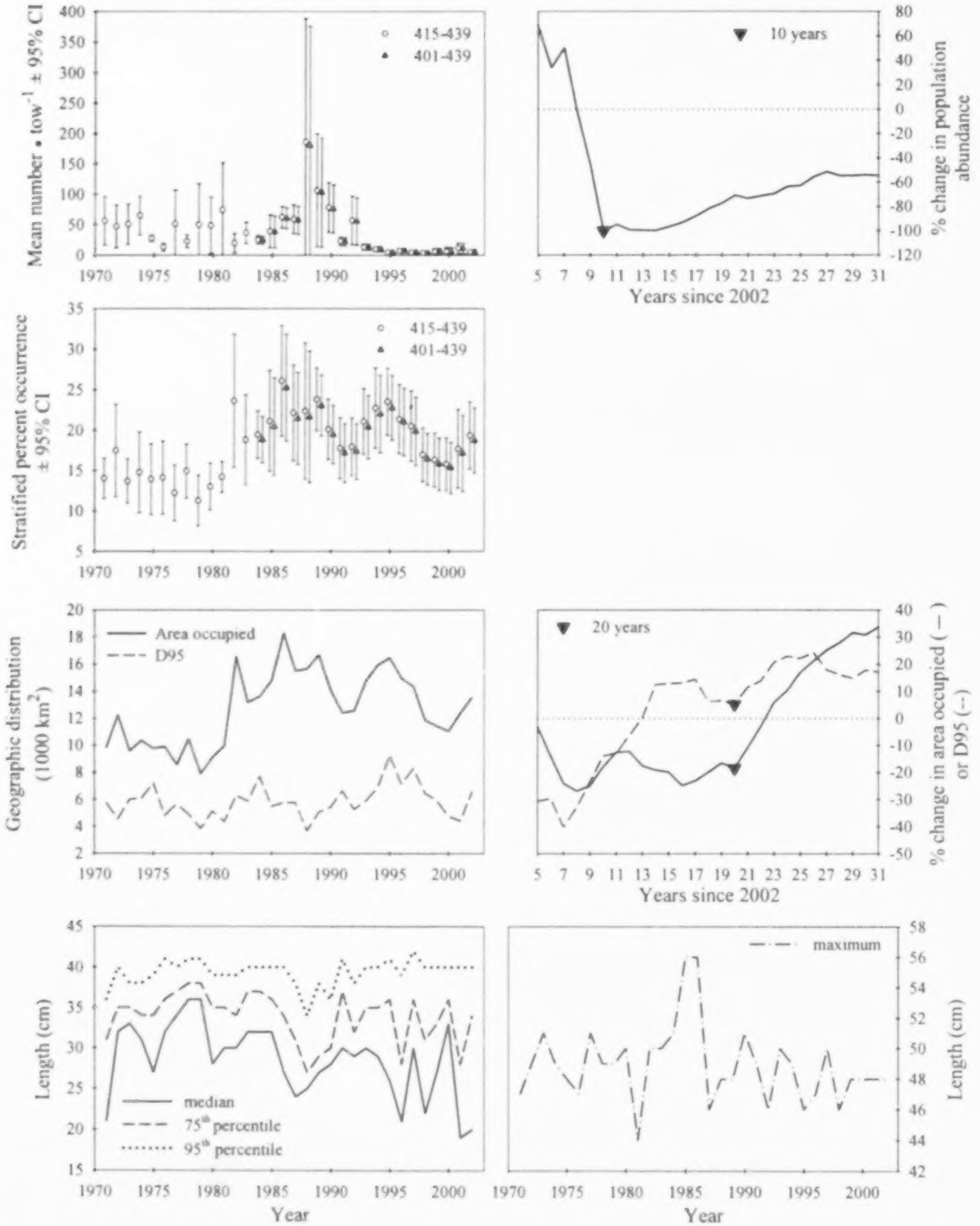

Figure 63a: Indicators of population status and distribution for redfish (unseparated), *Sebastes* spp. (1971-2002).

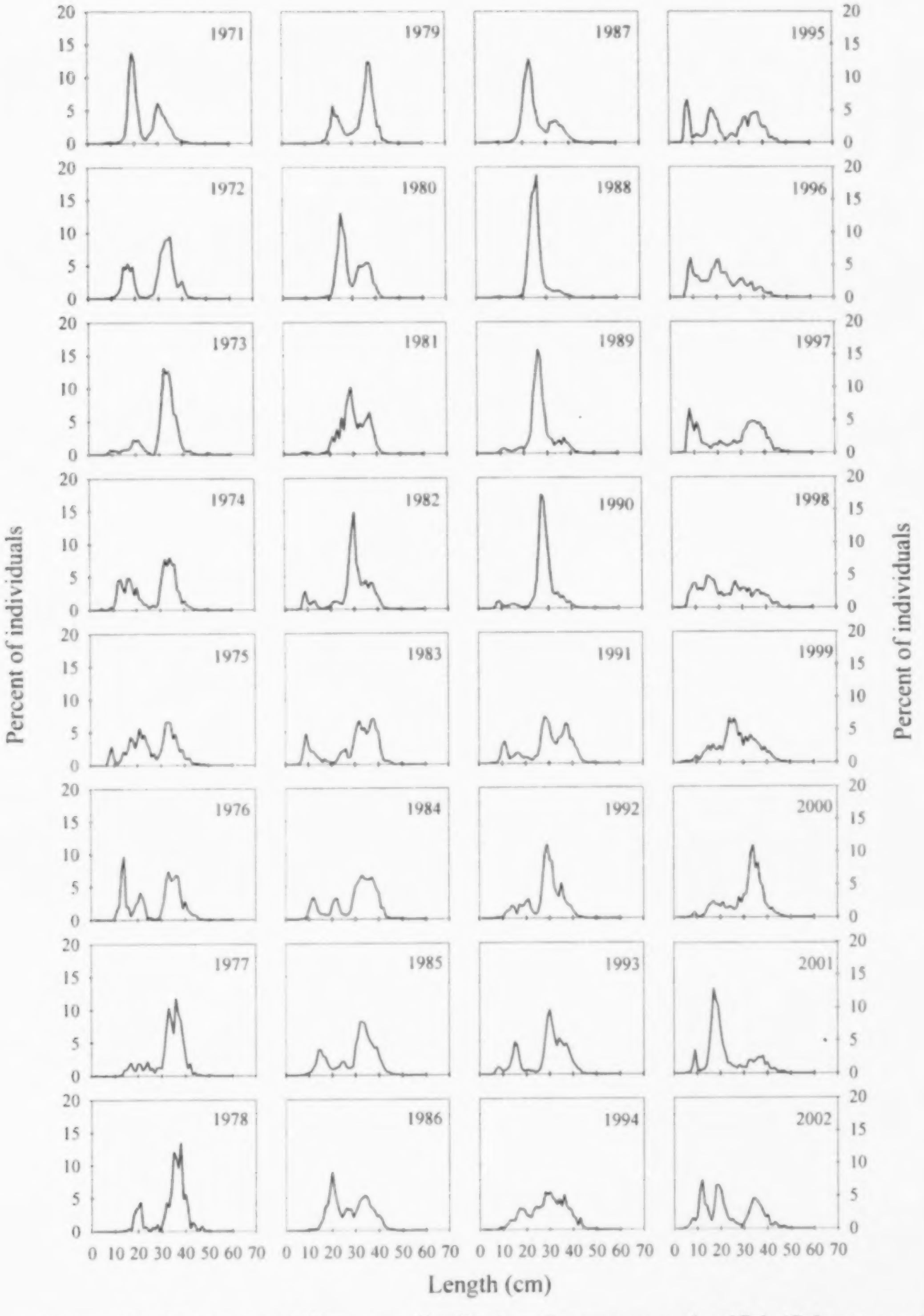

Figure 63b: Yearly length frequency distributions for unseparated redfish (*Sebastes* spp.).

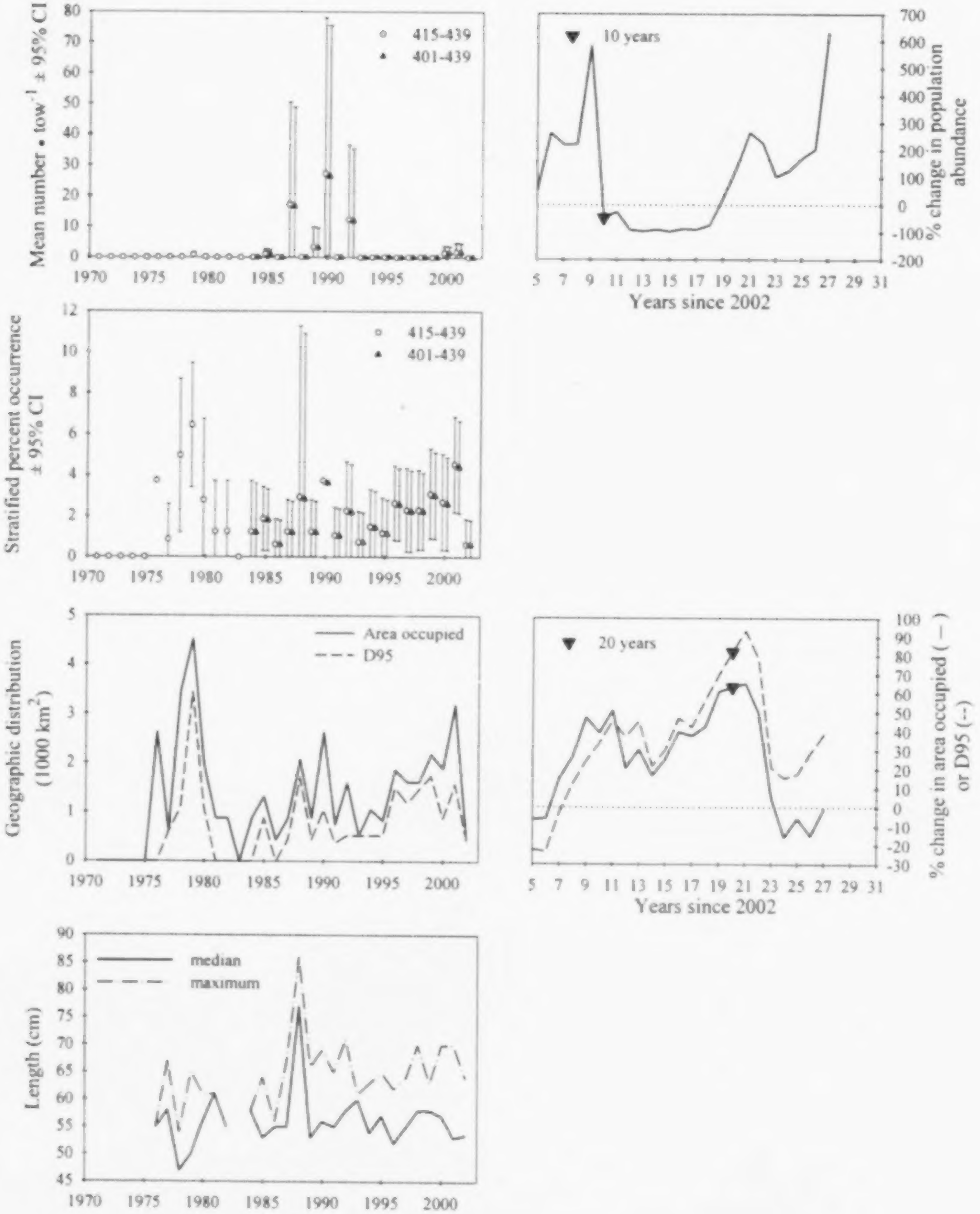

Figure 64a: Indicators of population status and distribution for black dogfish, *Centroscyllium fabricii* (1971-2002).

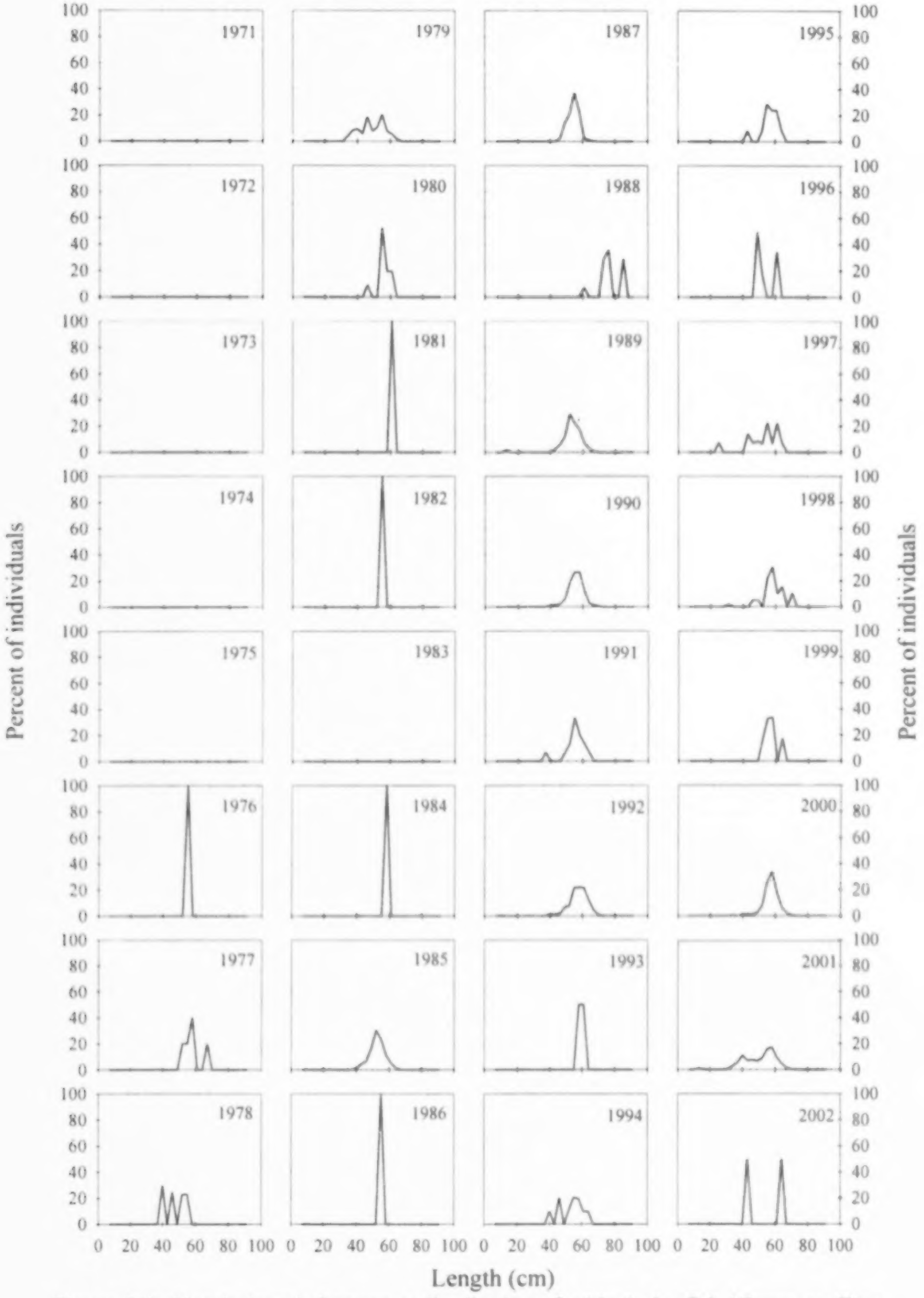

Figure 64b: Yearly length frequency distributions for black dogfish (*Centroscyllium fabricii*).

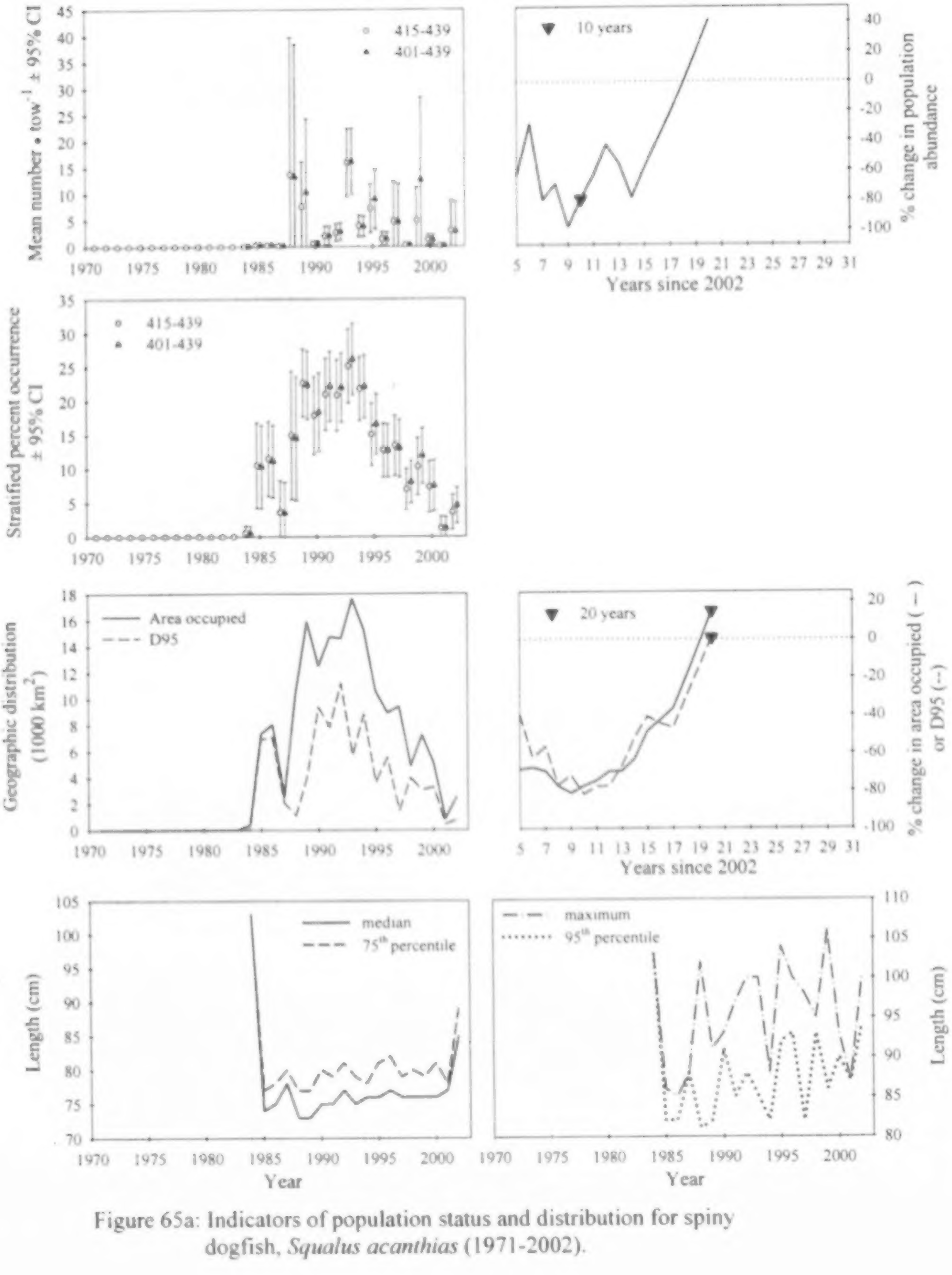

Figure 65a: Indicators of population status and distribution for spiny dogfish, *Squalus acanthias* (1971-2002).

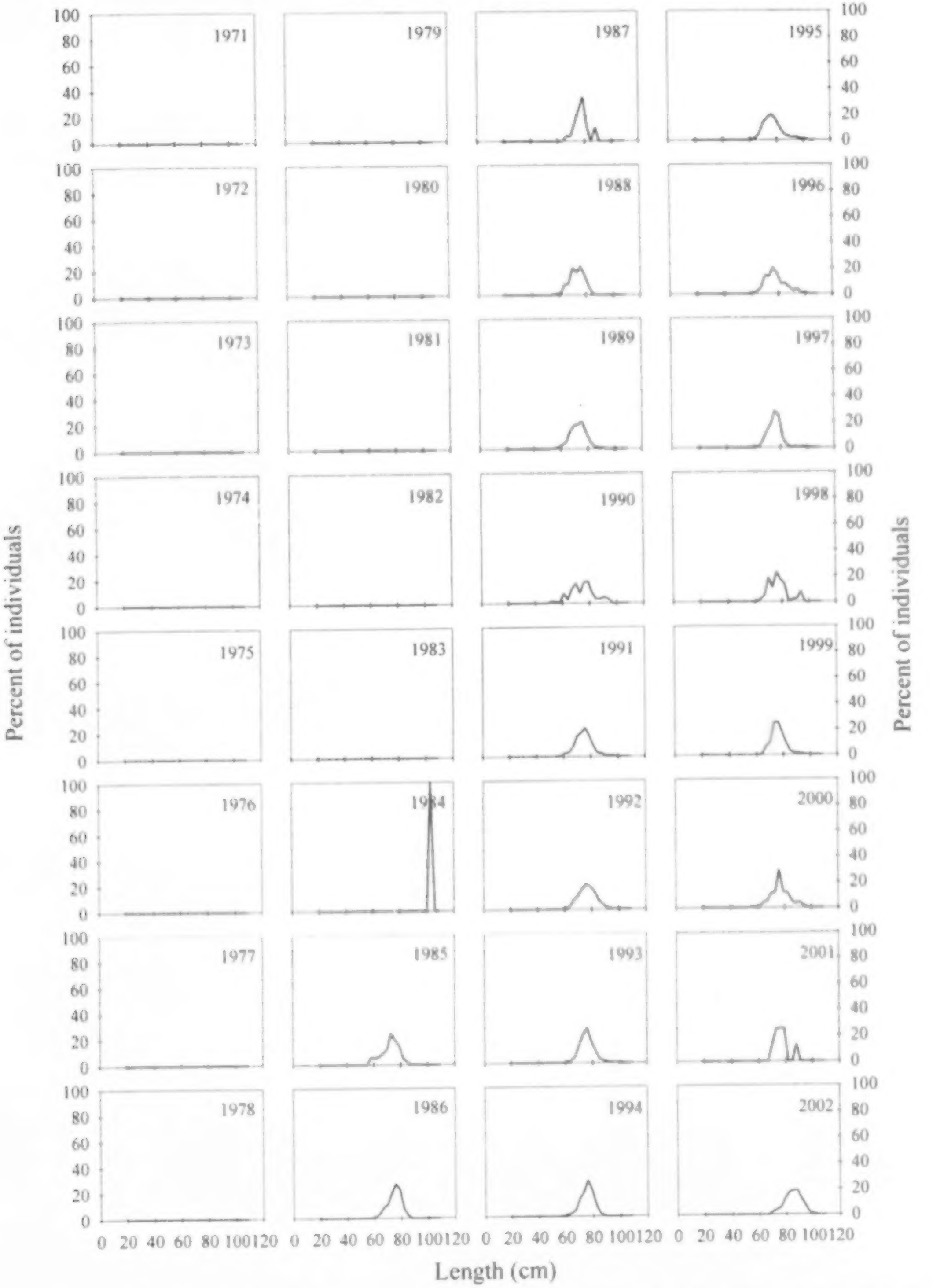

Figure 65b: Yearly length frequency distributions for spiny dogfish (*Squalus acanthias*).